SCIENCE TO SUPPORT THE NATIONAL COHESIVE WILDLAND FIRE MANAGEMENT STRATEGY

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Eastern Forest Environmental Threat Assessment Center
USDA Forest Service
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
An Overview Conceptual Model of Firefighter Safety Related to Incidents

- **Fuels management**
  - **Wildfire Extent and Intensity**
    - **Uncontrollable drivers (topography, weather)**
  - **Exposure**
    - **Situational awareness and hazard response**
      - **Training and experience**
        - **Equipment/Technology**
          - **Personnel standards**
            - **Learning**
              - **Firefighter Safety**
                - **Firefighter Safety Personnel standards**
                  - **Screening**
                    - **Personal responsibility**
                      - **Communications**
                        - **Mitigation**
                          - **Assignment**
                            - **Non-fire factors**
                              - **Hazards**
                                - **Hazard response**
                                  - **Incident management**
                                    - **Management Alternatives**
                                      - **Pre-fire**
                                        - **Training and experience**
                                          - **Equipment/Technology**
                                            - **Personnel standards**
Pathways to reducing firefighter deaths and injuries

<table>
<thead>
<tr>
<th>Strategic investment</th>
<th>Workforce emphasis</th>
<th>Incident management emphasis</th>
<th>Fire attribute emphasis</th>
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<td>Technology, equipment</td>
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<td>Communications</td>
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<td>Health monitoring</td>
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<td>Personnel standards, screening efforts</td>
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<td>Incident learning</td>
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<td>Fire behavior and weather modeling</td>
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<td>Wildfire prevention efforts</td>
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<td>Fuels reduction</td>
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<td>Forest and disease management</td>
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Position within Figure 2 shown by black and red:
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

<table>
<thead>
<tr>
<th>County-level Summary</th>
<th>Description</th>
<th>Example Map</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Urban Influence</strong></td>
<td>Urban Influence based on population and location. Small metropolitan area; Large metropolitan area.</td>
<td>![Map of Urban Influence]</td>
</tr>
<tr>
<td><strong>Urban Index</strong></td>
<td>Average urbanness value calculated from Edwards and Hargrove product.</td>
<td>![Map of Urban Index]</td>
</tr>
<tr>
<td><strong>Natural Ignitions</strong></td>
<td>Percent of known fires that were caused by natural ignitions.</td>
<td>![Map of Natural Ignitions]</td>
</tr>
<tr>
<td><strong>Vegetation Cluster</strong></td>
<td>Existing vegetation cluster based on LANDFIRE NVCS class information.</td>
<td>![Map of Vegetation Cluster]</td>
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</table>

- **ERS typology codes**
- **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 Collaborative 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 as 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 forests 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.

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 degraded from historical conditions, and are experiencing declining forest and rangeland health conditions, that are resulting in a cumulative buildup of fuel loads.

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
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).
General attributes of each landscape class

<table>
<thead>
<tr>
<th>Landscape Class</th>
<th>Percent Area Forested</th>
<th>Historical Fire Frequency</th>
<th>Index of Prescribed Fire Activity</th>
<th>Federal Ownership</th>
<th>Average Urban Value</th>
<th>Natural Landscape (%)</th>
<th>Natural-Mixed Landscape (%)</th>
<th>Counties</th>
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<tr>
<td>A Urban Developed Built</td>
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<td>B Cool, Wet Northern Forests</td>
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Legend: ○ Low  ○ Moderate  ○ High  ○ Very High
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
General attributes of each community cluster

<table>
<thead>
<tr>
<th>Community Cluster</th>
<th>Demographic Advantage</th>
<th>Demographic Stress</th>
<th>Maximum Annual Ignition Density</th>
<th>Area Burned (2000-2011)</th>
<th>WUI Area Factor</th>
<th>WUI Home Density Factor</th>
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<td>4 Suburbs on the Edge</td>
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○ Low ○ Moderate ○ High ○ Very High
## Intersection of Community Clusters with Landscape Resiliency Classes

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

Available online at http://cohesivefire.nemac.org/
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<tr>
<th>National Challenges</th>
<th>Management Options</th>
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<tr>
<td></td>
<td>Prescribed Fire: Expand or maintain in areas of current use</td>
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<tr>
<td></td>
<td>Prescribed Fire: Expand into areas of limited current use</td>
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<td>Prescribed Fire: Utilize on a limited basis</td>
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<td>Manage wildfires for resource objectives: In forested systems</td>
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<td></td>
<td>Manage wildfires for resource objectives: In non-forested systems</td>
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<td>Manage wildfires for resource objectives: In areas where increased awareness of community risk is necessary.</td>
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<td>Vegetation and Fuels</td>
<td>Non-fire Treatments: Supported by forest products industry</td>
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<td>Non-fire Fuels Treatments: In non-forest areas</td>
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<td>Non-fire Fuels Treatment: In areas with limited economic markets</td>
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<td>Fuels Treatments as a precursor to prescribed fire or managed wildfire.</td>
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<tr>
<td>National Challenges</td>
<td>Management Options</td>
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<tr>
<td>Homes, Communities, &amp; Values At Risk</td>
<td>Focus on home defensive actions</td>
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<td></td>
<td>Focus on combination of home and community actions</td>
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<td></td>
<td>Adjust building and construction codes, municipal areas</td>
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<td></td>
<td>Adjust building and construction codes, non-municipal areas</td>
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<tr>
<td>Human-Caused Ignitions</td>
<td>Reduce accidental human-caused ignitions</td>
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<td>Reduce human-caused incendiary ignitions (e.g., arson)</td>
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<tr>
<td>Effective and Efficient Wildfire Response</td>
<td>Prepare for large, long-duration wildfires</td>
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<td></td>
<td>Protect structures and target landscape fuels</td>
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<td></td>
<td>Protect structures and target prevention of ignitions</td>
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</table>
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
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
Example: Biscuit Fire
Reference conditions as phenology of adjacent unburned area
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
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