Strategic Plan Definitions

- Interactions among fire, other natural disturbance processes, and the physical biological components of ecosystems and the environment

- Better understand the relationships among varying fire behavior characteristics (e.g., energy release, residence time, flame length, and depth of burn) and fire regimes (e.g., fire size, distribution, severity, and return interval) and fire’s effects on vegetation, soils, watersheds, insects and disease, fish and wildlife, and carbon and nutrient cycling.
Relevance of Ecology

• Before the fire
  – ID Areas of potential opportunity/risk

• During the fire
  – Understand how fuels treatments impact fire behavior
    • How vegetation patterns drive fire behavior

• After the fire
  – Remediation treatment effectiveness/appropriateness
Capacity

- Personnel
- Technological
Personnel

USFS Fire Scientists
Total 283
USFS Fire Ecologists
Total: 37
# Productivity

**Keyword:** Fire Ecology

## Station Specific

<table>
<thead>
<tr>
<th>Station Name</th>
<th>Total Publications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forest Products Laboratory</td>
<td>43</td>
</tr>
<tr>
<td>International Institute of Tropical Forestry</td>
<td>21</td>
</tr>
<tr>
<td>Northern Research Station</td>
<td>203</td>
</tr>
<tr>
<td>Pacific Northwest Research Station</td>
<td>643</td>
</tr>
<tr>
<td>Pacific Southwest Research Station</td>
<td>412</td>
</tr>
<tr>
<td>Rocky Mountain Research Station</td>
<td>1390</td>
</tr>
<tr>
<td>Southern Research Station</td>
<td>283</td>
</tr>
<tr>
<td>Washington Office</td>
<td>63</td>
</tr>
</tbody>
</table>

**Total Publications in Google Scholar 2009-2014**

<table>
<thead>
<tr>
<th>Source</th>
<th>Total Publications</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSIRO</td>
<td>822</td>
</tr>
<tr>
<td>CFS</td>
<td>289</td>
</tr>
<tr>
<td>IBAMA</td>
<td>89</td>
</tr>
</tbody>
</table>
Cross Scale Expertise

- Landscape – physiology
Cumulative MODIS Fire Detections 9/4/12-9/4/13
Tale of Two Fires

![Bar chart showing million hectares burned in the Southern Region and Rest of US for Rx Fires and Wildfires. The chart indicates significantly more hectares burned in the Southern Region for both categories. The data is from 2011.](image)
Technological Capacity

• Remote Sensing
  – Piloted – remote controlled aircraft
  – LiDAR, IR imagery, photogrammetry, NDVI

• Ecosystem Measures
  – Eddy Flux, xylem sap flux, photosynthesis
  – Soils, respiration, carbon sinks
  – Watersheds, ecohydrology

• Models
  – Forest growth, carbon fluxes, insect population dynamics, stem heating, FOFEM, TBA
Key Research Needs

• Biophysical processes
• Vegetation responses
• Watershed Effects
• Insects and Disease
• Carbon Balance
Biophysical processes

Describe and model the linkages between fire behavior and fire effects on flora, fauna, and soils. Whenever possible, use this basic knowledge as a means of understanding and predicting ecosystem responses to fire.
How are fire and diversity linked?

• SERDP, SRS, RMRS, UNR, Air Force

Test for Neutral Processes within CA model:

• Plant mortality $\sim$ fire intensity (fuels)
• Plant recruitment $\sim$ random within recent mortality sites
Unified Model for Rx Fire
Fire-vegetation interactions

• Enhance basic knowledge of fire interaction with vegetation, including injury and mortality, recovery of vegetation and fuels, factors affecting postfire productivity and wildlife habitat, and the role of invasive species.
Stem Heating

- NRS, RMRS, SRS
Watershed Function

• Evaluate the effects of changing fire regimes on short- and long-term watershed processes, including water yield, water quality, erosion, fish habitat, and site quality or productivity.
Hayman Fire

- RMRS
Insects and Disease

- Quantify the relationships between insects and disease and fire disturbance, including the effects of insect and disease damage on fire regimes and effects of fire on insect and disease levels.
PSW, PNW
Management: Fire, Bark Beetles, and Climate

Baseline Climate, Fire, and Mgmt
High Emissions, Fire, and Mgmt
High Emissions, Fire, Mgmt, and Bark Beetles

Lake Tahoe Basin (CA, NV):
-- 80% Federal Lands (USFS)
-- Intensively managed (Thinning)

-- High future C storage potential (2nd growth forests)
-- Dependent on climate-fire-insects and future mgt.

Louise Loudermilk (Portland State), Carl Skinner (PSW), Alec Kretchun (PNW)
Carbon Balance

• Predict changes in carbon sequestration, storage, and release in relationship to changing climate, management, and fire regimes
Carbon

- PSW
- Promoting a more sophisticated understanding of how fire and carbon interact…

Figure 1: Carbon stocks and treatment emissions by treatment type. Figure adapted from North et al. (2009).
Productivity, Black Carbon
Tech Transfer
Knowledge Transfer

- RxCADRE
- Firefighter Science
The two “solitudes” in forest fire research...
Physical Sciences
Combustion, Heat

Fuels

Foresters, Ecologists
Fire Effects
Examples of Collaborations

• Forest Service:
  – Within/Among Stations

  – Among Government Agencies
    • Funded by JFSP, SERDP, ESTCP,

  – State and Private Entities
    • State Management Agencies
    • Universities
    • Private land owners (NGO’s)

  – Other Governments
International Outreach

Watch Out
No analog future

Fig. 3. A–D correspond to C–F in Fig. 1, except here, the pool of potential analogs is restricted to gridpoints within 500 km of each target gridpoint. (A) SED$_{21c}$, between the 21st-century realization for each gridpoint and the set of 20th-century climate realizations (A2 scenario). High dissimilarities indicate risk of regionally novel 21st-century climates. (B) As in A but for the B1 scenario. (C) SED$_{21c}$, between the 20th-century realization for each gridpoint and the set of 21st-century climate realizations (A2 scenario). High dissimilarities indicate risk of regionally disappearing 20th-century climates. (D) As in C but for the B1 scenario.
Rapid and Catastrophic Ecological Change

- Interactions among disturbances can have unexpected consequences...

Disturbance and the rising tide: the challenge of biodiversity management on low-island ecosystems
Read More: http://www.esajournals.org/doi/abs/10.1890/070221
Alternative Stable States

Facing the uncertain future

- Understanding future ranges of variation:
  - The past is no longer prologue…

- Mechanistic understanding
  - Mechanistic models

- Identifying tipping points
  - Providing rapid guidance
The No-Analog Future

- Changes will often be rapid and might require unprecedented or controversial interventions