

# Simulating Treatment Effects in Pine-Oak Forests of the Ouachita Mountains

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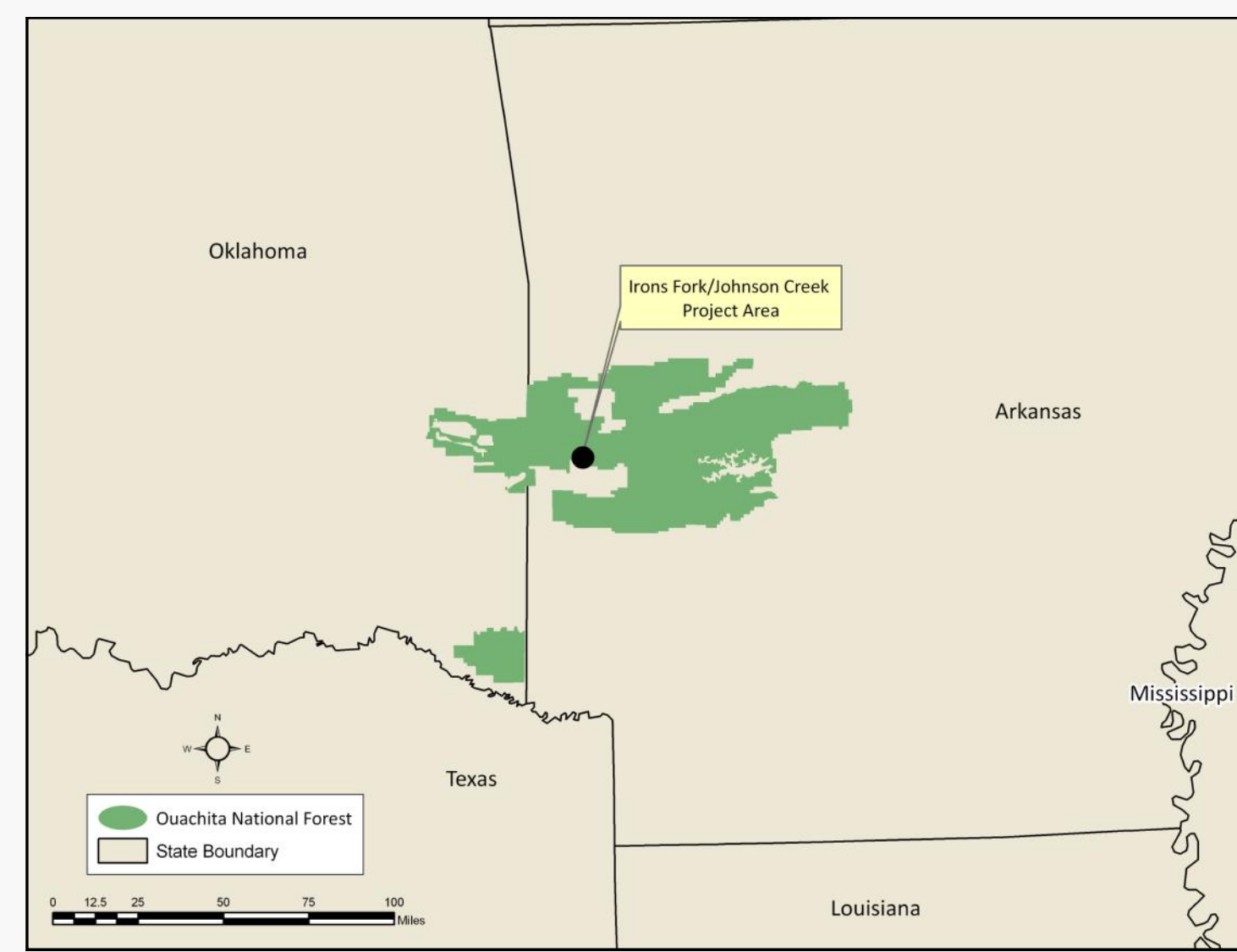
## OVERVIEW

Effective land management decision-making depends on scientifically-sound analyses of management alternatives relative to desired future conditions and environmental effects. This poster illustrates the use of a state-and-transition model to evaluate likely future landscape conditions in pine-oak forest on the Ouachita National Forest, Arkansas based on current and potential future alternative management actions. We used the model to simulate and compare the effects of several alternatives:

- A. Current Management
- B. Regeneration Harvest/Thinning
- C. Woodland Management
- D. B + Climate Change
- E. C + Climate Change

We compared all management scenarios to desired conditions specified in the Ouachita National Forest Revised Forest Plan (USFS 2005) and pre-settlement reference conditions from the LANDFIRE Ozark-Ouachita Shortleaf Pine-Oak Forest and Woodland model (LANDFIRE 2007). Effects included timber outputs, smoke production, fire frequency and insect and disease outbreak frequency over a 10 year period.

At the time of the study, a National Forest interdisciplinary team was completing a project-level environmental assessment of alternative management scenarios across the Lower Irons Fork/Johnson Creek watershed. The watershed is a drinking water source for the town of Mena, AR, offers recreational opportunities including hunting and fishing, is home to two federally-endangered species: the red-cockaded woodpecker (*Picoides borealis*) and the harperella plant (*Ptilimnium nodosum*).



## Study Area

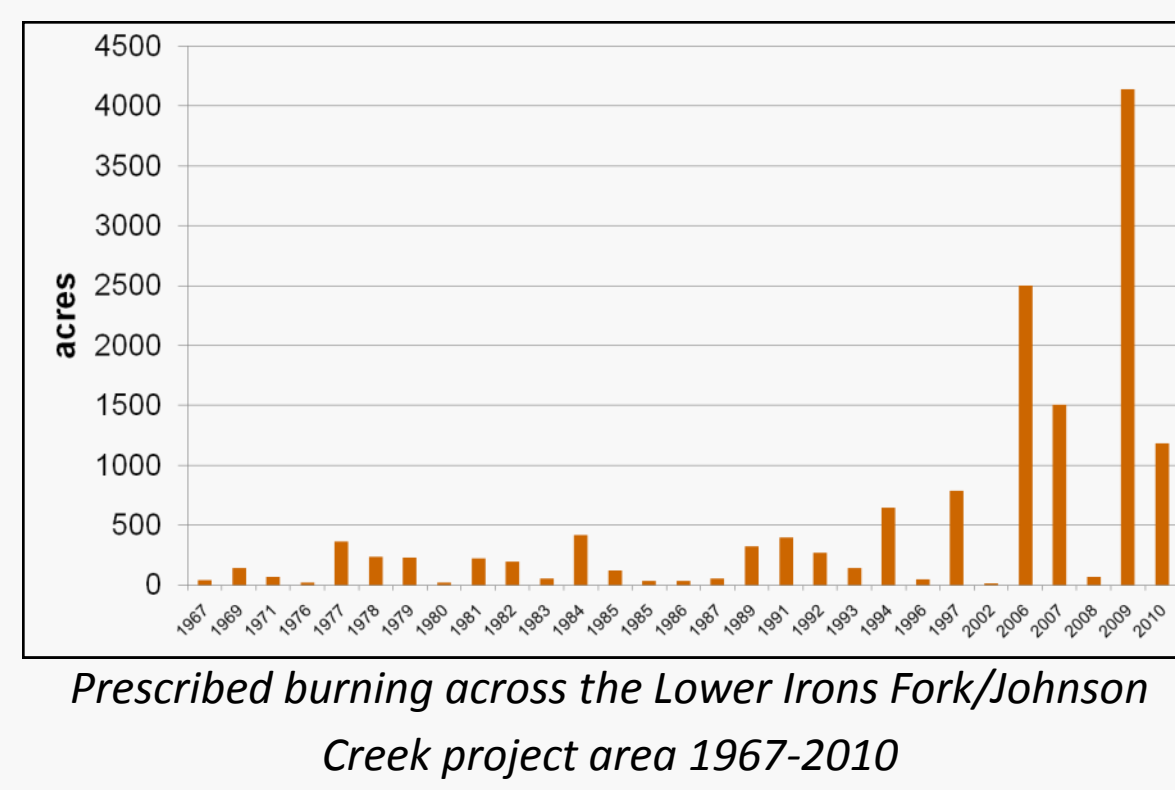
The Lower Irons Fork/Johnson Creek watershed is located within the Ouachita National Forest near the town of Mena in western Arkansas. The 16,700 acre watershed is comprised primarily of pine-oak forest and woodland and has a history of active fire management.

## Objectives

1. Demonstrate the use of state-and-transition models in project planning.
2. Create simple "what if" scenarios to supplement the project environmental impact assessment and facilitate more informed decision making through relative comparisons.



## History of Fire Use



## RESULTS

### No Action

- trends towards closed forest
- lowest fire occurrence and smoke production
- causes most frequent insects and disease outbreaks
- harvests no biomass

### Current Management

- low fire occurrence and particulate matter production
- results in more frequent insects and disease outbreaks than Regeneration Harvest and Woodland Management

### Regeneration Harvest/Thinning

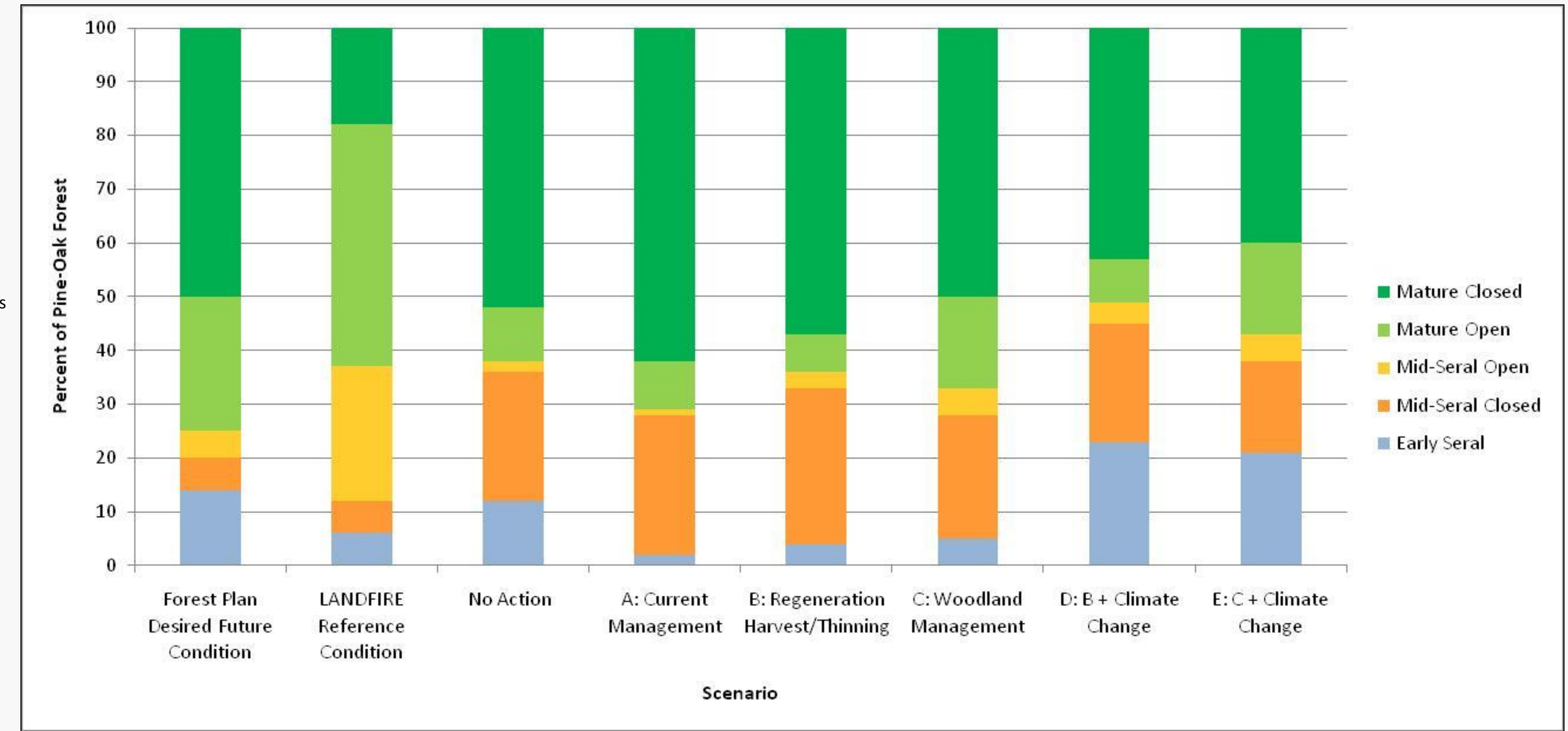
- yields 30% more closed seral structure than the Desired Future Condition
- produces less fire and particulate matter than Woodland Management especially under climate change

### Woodland Management

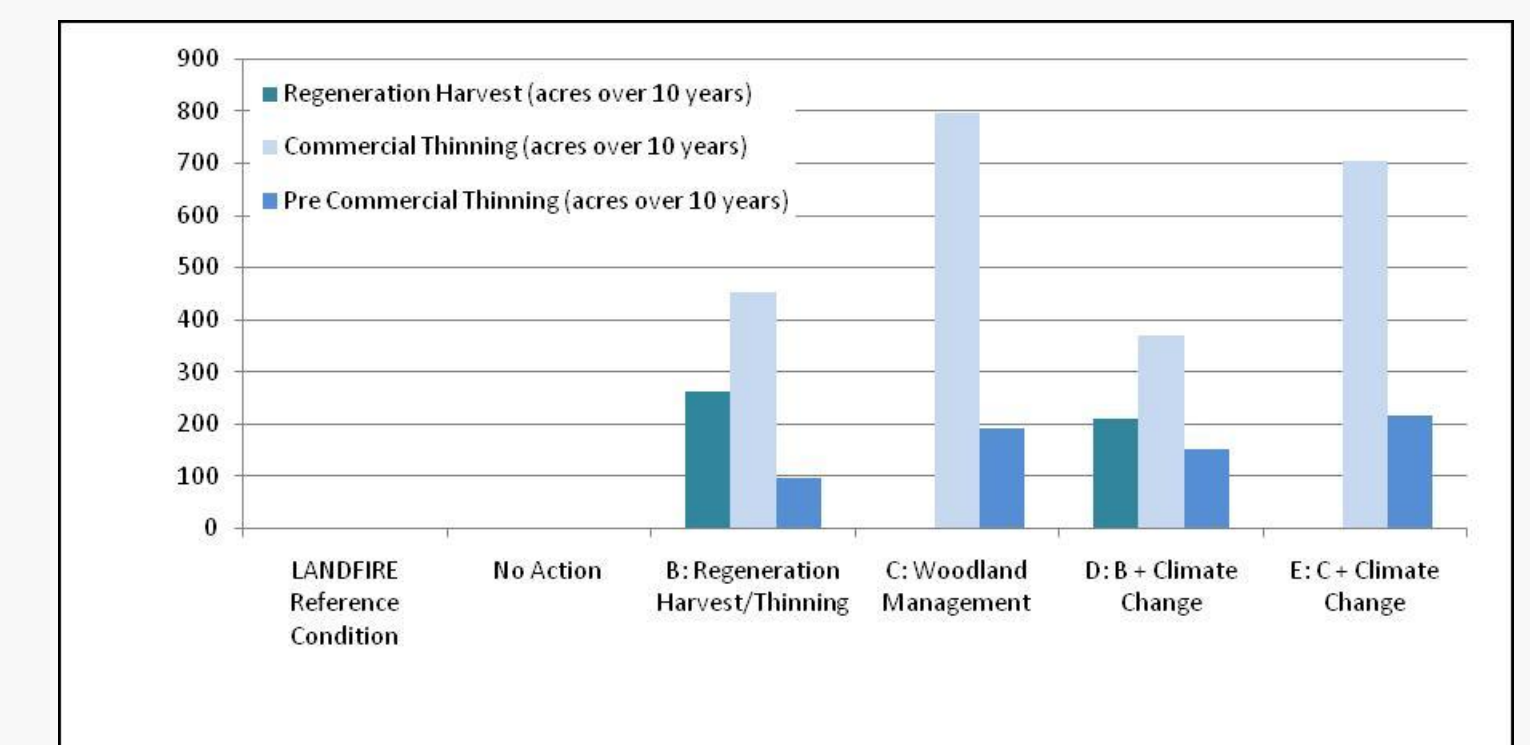
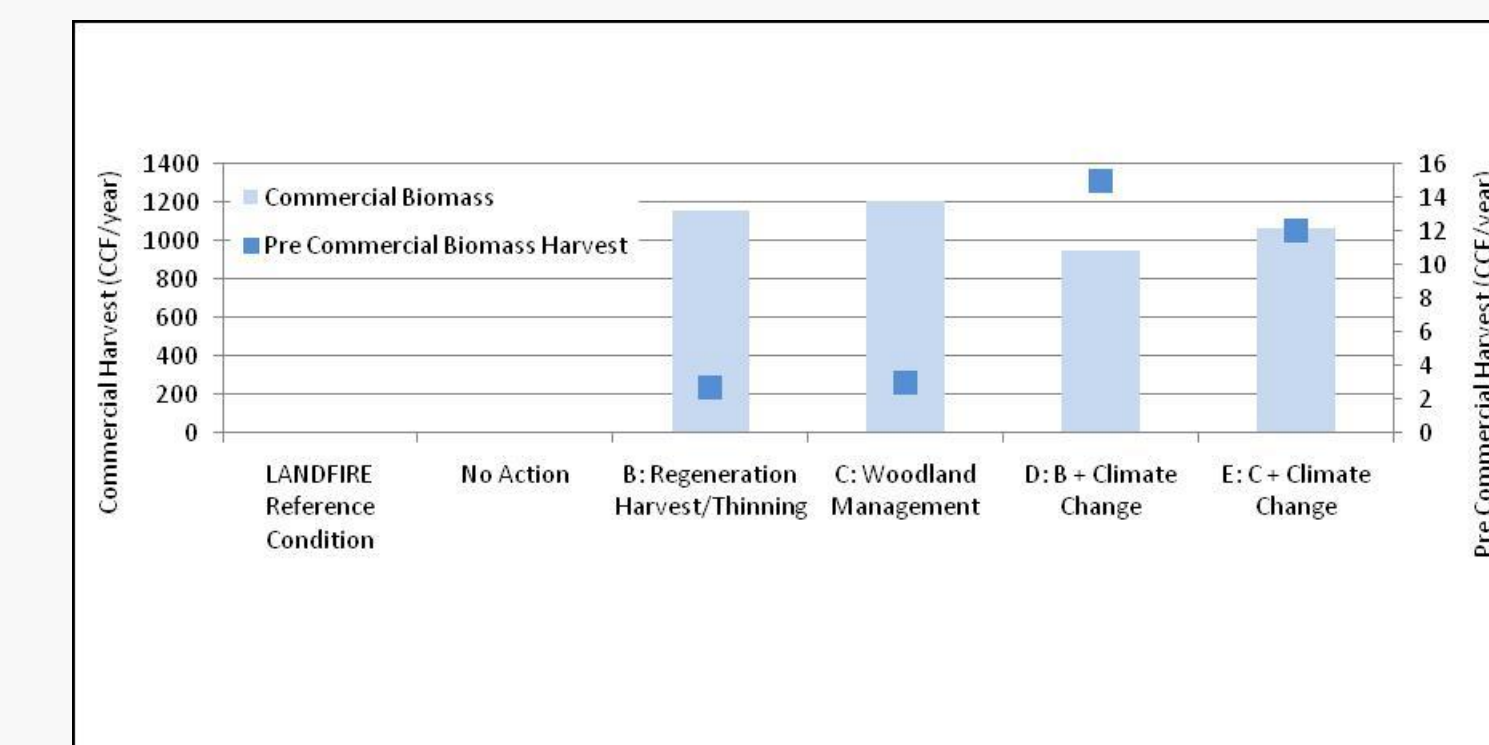
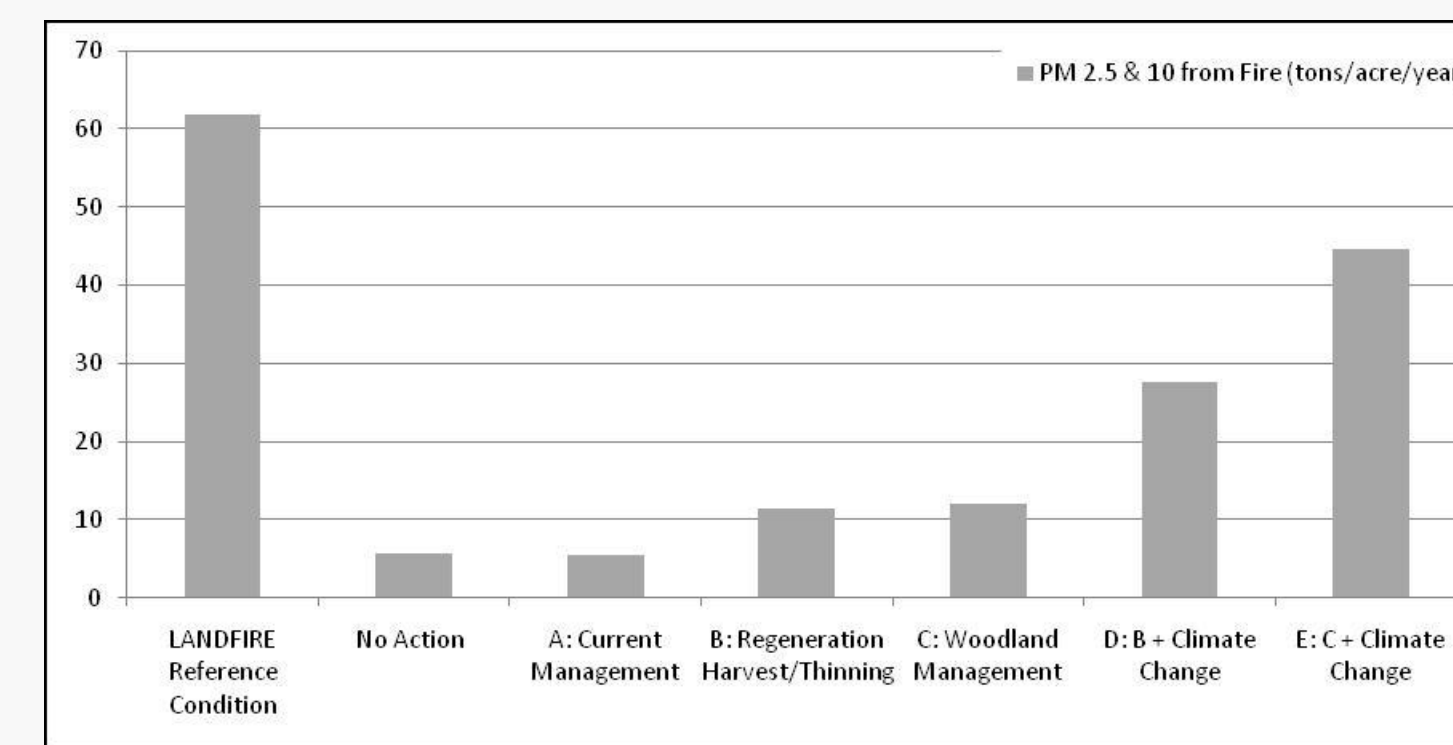
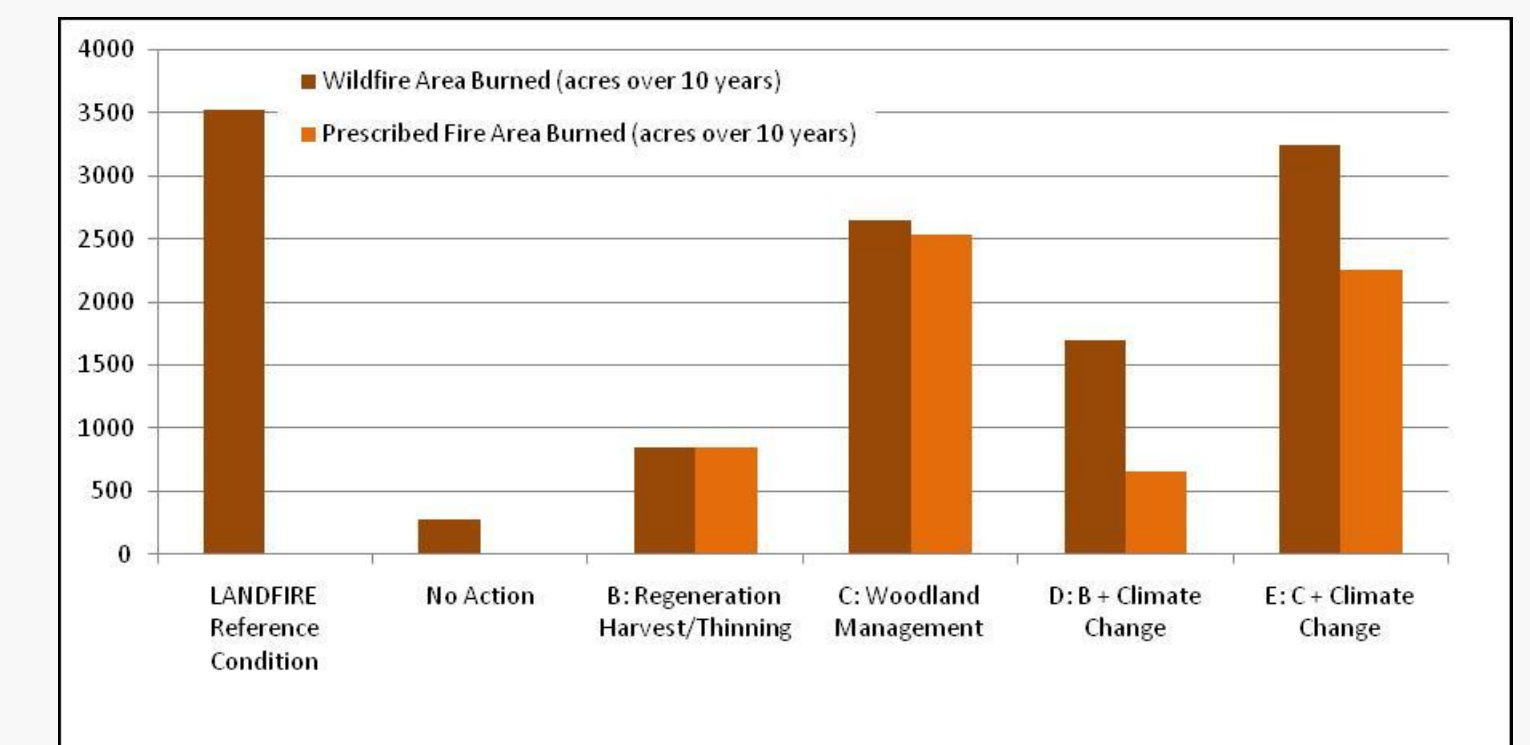
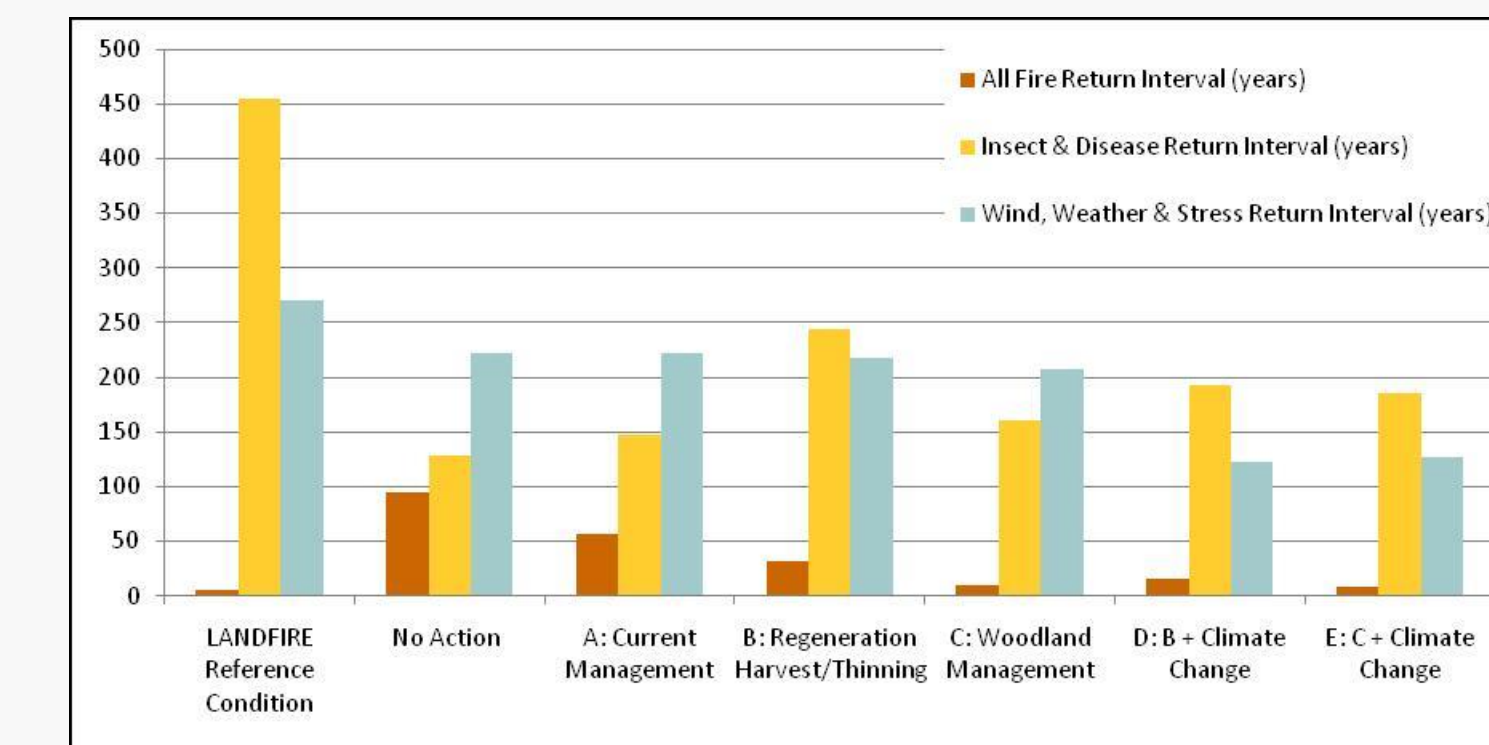
- doubles the amount of open forest compared to Regeneration Harvest/Thinning
- achieves fire frequency closest to Reference Conditions
- highest biomass harvest

### Climate Change

- achieves most early seral structure
- produces more particulate matter than other scenarios
- yields less commercial biomass than Regeneration Harvest/Thinning and Woodland Management



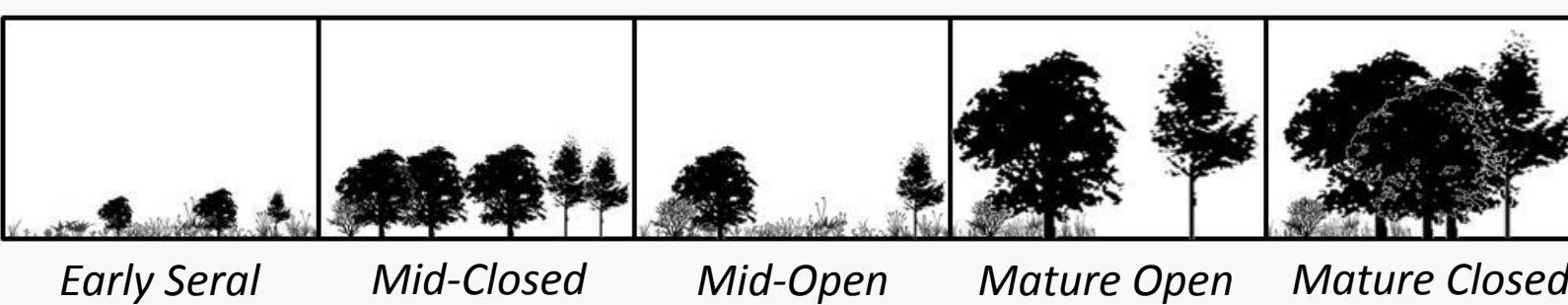
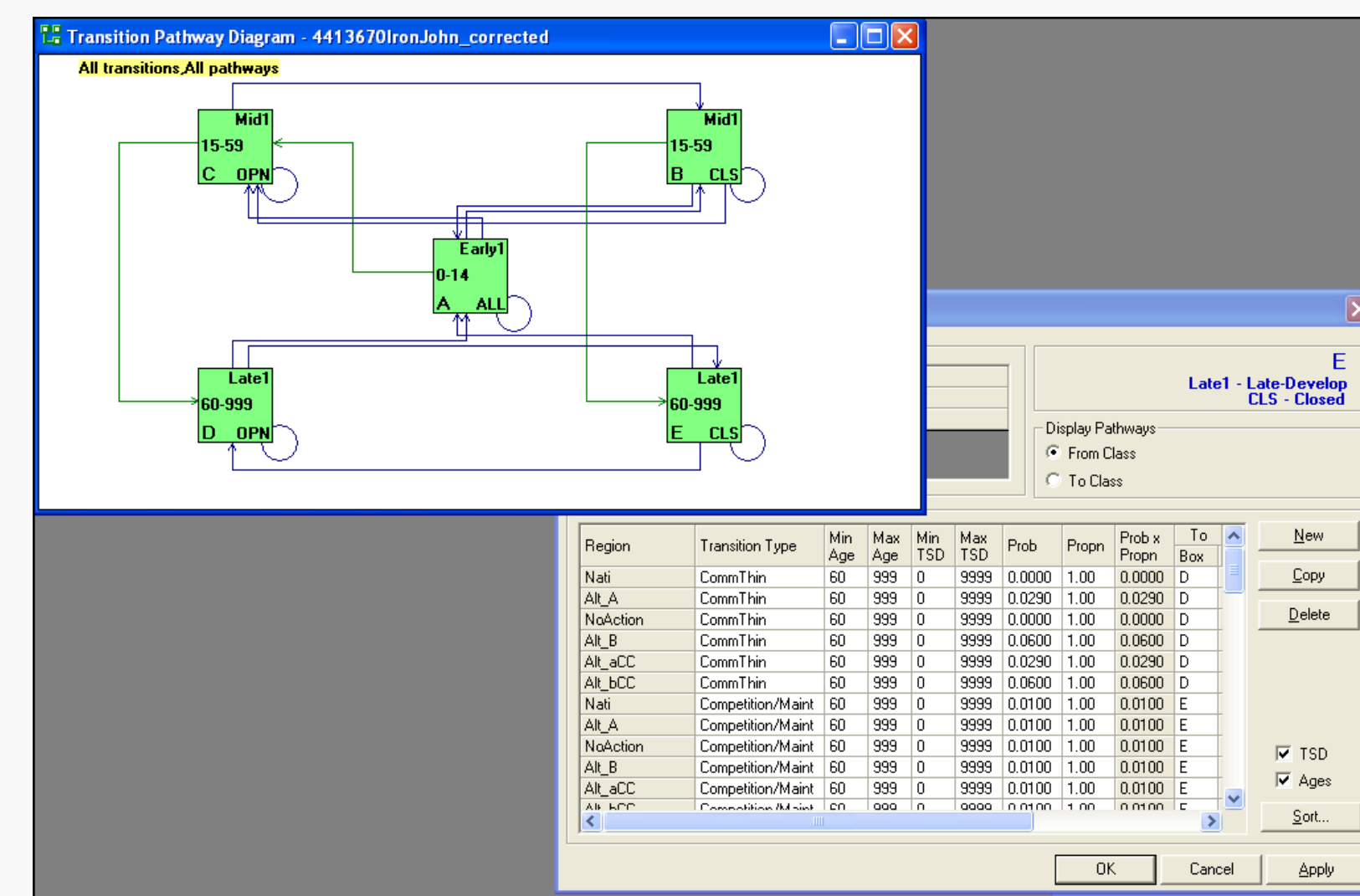
Simulated pine-oak forest and woodland structure after 10 years under different management scenarios compared to desired conditions as stated in the 2005 Ouachita National Forest Revised Forest Plan and LANDFIRE reference conditions



## METHODS

We created a pine-oak forest and woodland model using the Vegetation Dynamics Development Tool, a state-and-transition modeling framework, to simulate the effects of the various alternatives.

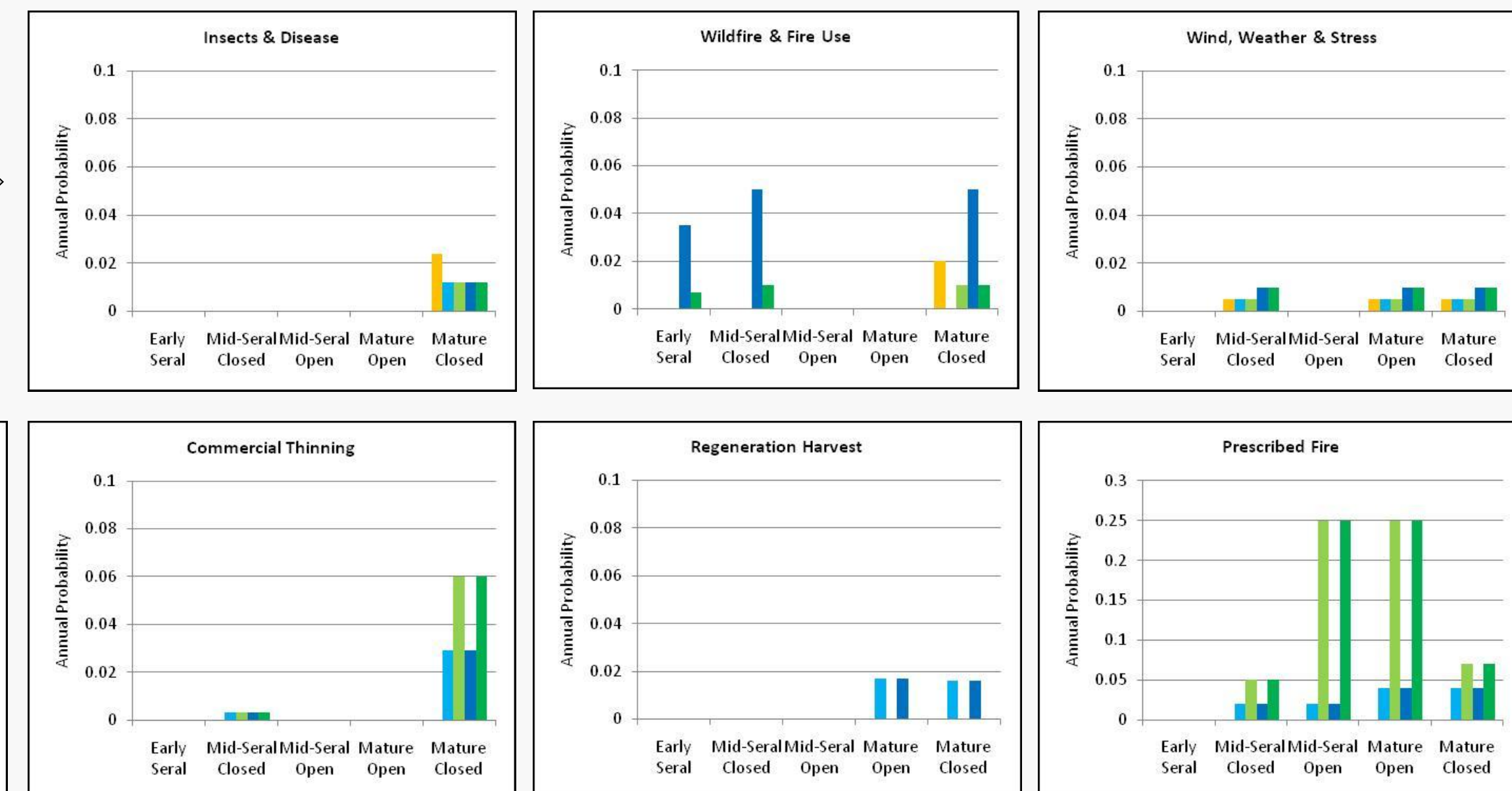
1. Calculated current condition from stand exam data.
2. Modified LANDFIRE pine-oak model to include management activities.
3. Attributed model with timber and smoke production values (estimated wildfire particulate matter (PM 10 and 2.5) output using FOFEM; estimated commercial harvest volumes from a similar unit).
4. Solicited peer-review from Forest colleagues and USFS Southern Research Station scientists
5. Ran model and compared simulation results after 10 years.



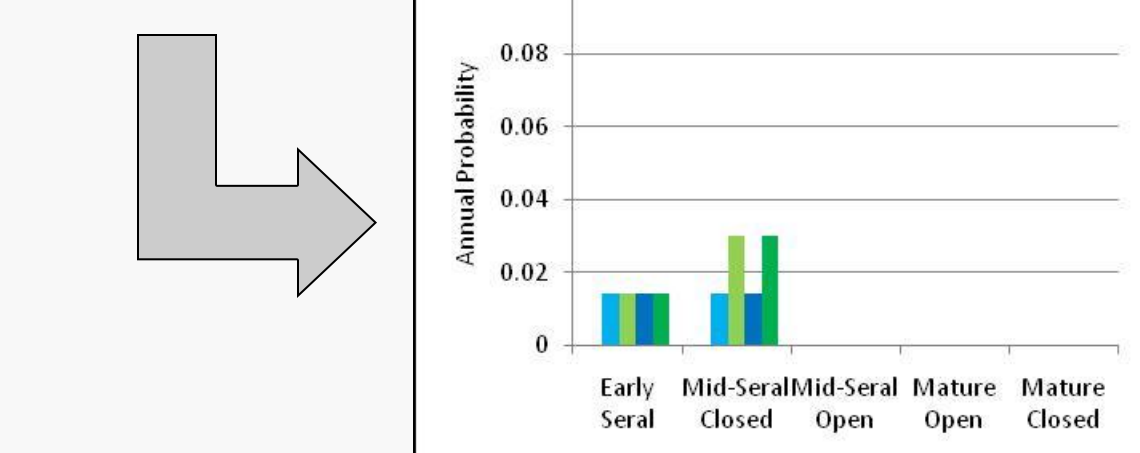
## Management Scenarios

### Disturbance Probabilities

- NA: No Action
- B: Regeneration Harvest/Thinning
- C: Woodland Management
- D: B + Climate Change
- E: C + Climate Change



### Treatment Probabilities



## CONCLUSIONS

- ◆ Woodland Management emphasis generally yielded landscape structure and fire frequencies closer to the desired future condition specified in the Ouachita National Forest Revised Forest Plan compared to other scenarios
- ◆ Woodland Management emphasis is more similar to pre-settlement reference conditions and may therefore be more ecologically resilient to disturbance.
- ◆ There is a tradeoff between achieving desired conditions and increased woody biomass harvest under Woodland Management and reduced smoke production under the No Action and Regeneration Harvest/Thinning scenarios; however, fire events in the No Action scenario are likely to be released in large pulses whereas emission events are likely to be smaller and spread out through time under the other scenarios. All management scenarios produce less smoke than that expected under Reference Conditions.
- ◆ Increased storm frequencies, such as modeled in the Climate Change scenarios, may result in more early seral structure and may exacerbate current lack of open, woodland conditions.
- ◆ Developing local assumptions for climate change adaptation and mitigation would improve the model.
- ◆ Forest Plan revisions should reevaluate the desired future conditions for pine-oak forest because:
  1. the current plan does not have a standard for mid-seral forest structure; and
  2. the existing desired future condition standard for late seral open woodland is lower than LANDFIRE reference conditions.
- ◆ LANDFIRE reference condition models can be easily adapted to analyze alternative management scenarios and test management and climate change assumptions.
- ◆ Testing assumptions and documenting knowledge are two intangible but valuable modeling outcomes.

