What’s up with eastern Oak forests?

- History and status
  - Disturbance regime changes
    - Harvesting
    - Fire
    - Grazing/Browsing
  - Loss of American chestnut
  - Age class shift
    - Understory is more shade tolerant

- Why do we have an oak regeneration problem?
  - Oak forests rely on natural reproduction
  - Absence of large, advanced reproduction
  - Probability of stump sprouting for large trees is low
Changes in land use history and the forests of today
Current Drivers of Landscape Character
Changing Management Policies and Practices

Fire Suppression

Timber Harvest on National Forests
Where are we today?
* Contemporary forests are ______________
* Homogenization of the forest landscape
* Loss of forest resiliency
* Need for active forest management to promote oak ecosystems and diversify the landscape

60 to 70% of eastern forests are 40 to 100 years old

Shifley et al. 2012

With developing shade tolerant understories
Dominated by woody species and shade tolerant forbs in the understory
Contemporary Upland Oak Forests

Overstory oaks mature 80 to 120+ yrs

Oak reproduction— advanced growth dependent

Oak advance reproduction is absent or small (not competitive)

Midstory oaks scant or missing

Abundant shade tolerant species
OAK-FIRE HYPOTHESIS

- Multiple fires can affect a fire-mediated shift from mesophytic species in favor of oak

- Oaks have characteristics that are more ‘tolerant’ to fire
  
  - Thick bark (only when they get big enough)
  
  - Sprouting
    - Buds below ground and protected from fire
    - Allocate more carbon to roots, helps respond to top-kill
Lack of disturbance (fire, harvesting) has affected a disturbance-mediated shift away from xeric-phytic species.

Most if not all small hardwood seedlings will be top-killed by fire.

Most if not all small hardwoods will sprout after top-kill.

Change in disturbance = change in species assemblages.

EXAMPLE: Red maple sends up lots of sprouts

- high photosynthetic capacity (more sprouts = more leaves)
- Food energy used to grow taller and fatter
- Outer sprouts act as sentinels
Why use fire?

• Restoring a process that has been lost/ restoration ecology
• Reduce fuels
• Create a habitat type that has been diminished - woodlands and savannas
• Habitat heterogeneity (wildlife, resilience, forest health)
• As part of the oak regeneration process
Can we use fire to recruit small oak advance reproduction into more competitive positions?
Stand development considerations

Mature stands in the understory re-initiation stage

REGENERATION PROCESS

Stand initiation stage
Oaks are adapted to frequent mixed severity disturbances that create open environments

~20% full sunlight (under a canopy) favors oak over other species

30 to 50% full sunlight good oak seedling growth

50 to 100% full sunlight maximum growth

Shade Tolerance

White oak

Intermediate

Scarlet oak

Intolerant

Shade Tolerance
Fire by itself is a mediocre means to increase understory light

Cumberland Plateau, Bankhead NF, AL
Mixed pine-upland hardwood forests
Using thinning and burning
Move stands towards oaks
To recruit oak, make growing space

Introduce a series of disturbances which may include fire

Grow small oak into more competitive positions

- Regeneration is a process
  - Shelterwood
  - Seedtree with reserves
  - Two-aged stands

Plus fire?
Meta analysis of prescribed fire and oak

Brose et al. 2013

Multiple fires cause a reduction in sapling and pole densities

Oaks and mesophytic species sprouted

Prescribed fire did not change the proportion of oak reproduction

Three dormant season fires were needed to equal the impact of one growing season fire

Residual tree damage concerns
Dormant season fires

Decline in density for 1.6-4.0" dbh stems, oaks, after 1, 2 and 3 prescribed burns on the William B. Bankhead National Forest, AL
Prescribed fire and oak

Site preparation by burning-

Reduced litter readily accumulates
Germination not always an issue
*recruitment is

**Oak seedlings depend on acorns**
Acorns can be killed by fire
Acorn production is sporadic
Oak germinants susceptible to fire

Can decrease midstory density
Often a long-term endeavor

Red maple drops seeds late spring
Prescribed fire and oak

Recruitment by burning

**must have reproduction present**
need to increase understory light
requires multiple fires
indiscriminate top-kill
there will be lots of sprouting

Alternatives

reduce midstory shade and competition by herbicide
recruit oaks
herbicided competitors are dead=no sprouts

Shelterwood phase I to reduce overstory 45-65 BA residual
burn after oaks establish bigger roots
Shelterwood Burn Prescription
VA Piedmont, upland oak forest
Cut to 57 ft²/a
Burned 4 growing seasons after harvest
One burn each season
Multiple stems from a rootstock counted as one
Fire improves species composition of reproduction but this is temporary

Need multiple fires

After one fire, 11 years, VA Piedmont:
April (SprB), August (SumB), February (WtrB)
Blue Ridge, Pisgah NF, NC
Upland hardwood forests
Dormant season burn March
Growing season burn April

3 years POST burn:

Seedlings densities
Red maple
Red oak and
White oak

did not differ between burn season

Red maple has a height advantage
When to do it: Prescribed fire and oak recruitment

Can burn after the initial shelterwood harvest
OR wait a few years to allow oaks to allocate carbon to roots
OR burn *when you can to get it in*

Assess the stocking of your oaks  
– what would fire buy?

Timing- bud burst of competitors
Cumberland Plateau, Bankhead NF, AL
Mixed pine-upland hardwood forests
Using thinning and burning
Move stands towards oaks

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<th>Block</th>
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Bankhead NF thin and burn study: reproduction >1 ft tall up to 1.5” dbh

Heavy thin treatment (50 ft²/a BA)
Pretreatment and following 3 burns

clumps per acre
sprouts per acre

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<tr>
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Change after 7 growing seasons following one thin to 50 ft²/a BA and three fires

- Oak
- Red maple

Sprout height classes:
- clump
- <1'
- 1.2'
- 2-3'
- 3-4.5'
- 4.5'-1.5" dbh

Change in #/acre
#/acre after 7 growing seasons following one thin to 50 ft²/a BA and three fires

Sprout height classes

- clump
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Timing may be the answer:

Hit the understory with the hottest fire allowable when undesirables are budding out

Pluralism of prescribed fire: seasonality, intensity, thinning
• Phases: First: Shelterwood/thinning
• Phases: Second: Remove overstory
• Treat understory before harvest? After harvest?

Red maple

Oaks
Release burning

- Stand at end of oak regeneration process
- Size and numbers of oak adequate
- Hot spring burn when mesophytics are 50% leafed out and oaks are still dormant
- Challenges
Prescribed Fire is Not Magic Pixie Dust!

-Stephen Pyne

- Fire as a process vs a tool
- Don’t use it because you ‘have to’ burn
  - Fire should not drive silvicultural decisions
- Pluralism: Timing, frequency, intensity
- Mixed outcomes- oak reproduction
- Site drivers: stand/landscape, mesic, xeric, prior disturbance, current status
- Future timber quality
- Planning and policy concerns
- There are reasons to burn other than oak recruitment
  - Herbaceous understory
  - Woodlands/savannahs
  - Insect diversity
  - Wildlife habitat
  - Fuels reduction
Prescribed Fire’s Place in Oak Regeneration

Callie Schweitzer
Research Forester
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