Historical Fire and the Species that Coevolved with it in the South:

What Should We Be Doing with Fire Now?

Cecil Frost, PhD
Landscape Fire Ecologist
Research Associate
University of North Carolina
119 Potluck Farm Road
Rougemont, NC 27572
cecil.frost@earthlink.net
336-364-1924 Home office
919-906-1915 cell
Objectives for today

1. KNOW WHERE WE ARE GOING
   (given “the way things are”)

2. GET ON THE SAME PAGE
   about what we need to do with fire in the field in the next 10 years

• Restoring Fire Integrity

• Using Focused Fire
The earth, born in fire, baptized by lightning, since before life’s beginning has been and is, a fire planet

E.V. Komarek
Paleowildfire

- 500+ MYA, Late Cambrian – planetary oxygen levels first reach the minimum needed to support ignition, fusainite (fossil charcoal) found!
- 458 MYA, Upper Ordovician – first land plants (nonvascular)
- 431 MYA, Mid Silurian - first tracheids (basic component of wood) – Oxygen approaching modern levels
- 418 MYA, Early Devonian – first true leaves (with tracheids)
- 360 MYA, end of the Devonian, beginning of the Carbonaceous – extensive swamps $\rightarrow$ coal beds $\rightarrow$ abundant charcoal
- Lower Carbonaceous – first bark (an evolutionary adaptation to fire) $\rightarrow$ Lightning scars found on fossil tree trunks in coal mines (fulgurites much earlier)
- 129 MYA (early Cretaceous)– first grasses – modern frequent fire regimes possible?

- $< \frac{1}{2}$ MYA million years – the smart monkeys (Neanderthal and Homo sapiens).
- 13,000 YBP in North America – Clovis hunters appear with primitive drip torches
- 4000-6000 YBP prairie grasslands extended into eastern US

As soon as there was fuel there was fire!
OUR MISSION AS SEEN BY THE CONSERVATION COMMUNITY

in the

IMPENDING CRISIS OF SURVIVAL OF BIODIVERSITY ON THE PLANET

• Restoration is passé, “you can’t bring back the past”
• We need to work to protect “Focal Species” such as tigers, Elk or Sage Grouse and everything else will work out (Lambeck 1978 & many others, Conservation Biology)
• “We can’t save all the species”

• For the future we can expect Dichotomization of All Lands into:
  1) Multifunctional Landscapes (including “working landscapes” with some natural values, novel ecosystems) – used for diversified production to meet human wants and needs (in response to the drive for “sustainable intensification in agriculture” (A plea for multifunctional landscapes. 2017. Frontiers in Ecology)
  2) Lands wholly converted to Production (intensive agriculture, cities, factories, monoculture timber lands)
SAVING SPECIES DIVERSITY FROM THE PERSPECTIVE OF THE FIRE COMMUNITY

THE GREAT TRIAGE

1. Natural areas reserved for full restoration from the bottom-up with fire. Nothing short of full restoration of the natural fire frequency across these ands will provide for survival of all our native species of birds, plants and animals

2. Multifunctional Landscapes (Working Landscapes à la TNC, Novel Landscapes) For supplying human wants and needs while preserving a modicum of natural values (timber, cattle, recreation)

3. Lands completely converted to Production to met human wants and needs
The Nature Conservancy’s Matador Ranch in Montana

Domain 2: Multifunctional Landscapes

60,000 acres and 266,000 acres under voluntary conservation easements with local ranchers
Domain 1: Restored Landscapes

Charles M Russell NWR, Montana
The Barrens of Kentucky and Tennessee appear to have experienced a lightning-driven fire regime with only minor contribution by Native American burning.
Venus flytrap – an ancient species
The most fire-dependent species known

Evolutionarily adapted to nitrogen-poor, frequent-fire environments

- Has a remarkable suite of adaptations
  - The trap
  - A digestive mechanism
  - A triggering algorithm

Guyette1-4
Great Plains Grasslands

15 states and provinces
### SPECIES RICHNESS OF SEVEN CLASSIC GENERA OF FIRE-MAINTAINED GRASSLANDS

#### PRAIRIE REGION

*(Great Plains and Midwest)*

<table>
<thead>
<tr>
<th>Species</th>
<th>PRAIRIE REGION</th>
<th>SOUTHEAST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Andropogon (big bluestems)</td>
<td>2 spp.</td>
<td>6 spp. in KY and TN</td>
</tr>
<tr>
<td></td>
<td></td>
<td>11 spp. in Louisiana</td>
</tr>
<tr>
<td></td>
<td></td>
<td>16 spp. in North Carolina</td>
</tr>
<tr>
<td></td>
<td></td>
<td>19 spp. in Florida</td>
</tr>
<tr>
<td>Sorghastrum (Indiangrasses)</td>
<td>1 sp.</td>
<td>2 spp. in KY and TN</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4 spp. in Southeast</td>
</tr>
<tr>
<td>Schizachyrium (little bluestems)</td>
<td>1 sp.</td>
<td>1 spp. in KY and TN</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 spp. in North Carolina</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5 spp. in Louisiana</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10 spp. in Florida</td>
</tr>
<tr>
<td>Liatris (blazing-stars)</td>
<td>10 spp.</td>
<td>11 spp. in KY &amp; TN</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5 spp. in Louisiana</td>
</tr>
<tr>
<td></td>
<td></td>
<td>12 spp. in North Carolina</td>
</tr>
<tr>
<td></td>
<td></td>
<td>14 spp. in Florida</td>
</tr>
<tr>
<td>Echinacea (coneflowers)</td>
<td>3 spp.</td>
<td>4 spp. in KY &amp; TN</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9 spp. in Southeast</td>
</tr>
<tr>
<td>Baptisia (wild indigos)</td>
<td>5 spp.</td>
<td>7 spp. in KY &amp; TN</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5 spp. in LA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6 spp. in NC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>11 spp. in FL</td>
</tr>
<tr>
<td>Helianthus (sunflowers)</td>
<td>14 spp.</td>
<td>19 spp. in KY &amp; TN</td>
</tr>
<tr>
<td></td>
<td></td>
<td>19 spp. in LA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>21 spp. in NC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>19 spp. in FL</td>
</tr>
</tbody>
</table>

*(Alan Weakly, Univ. of North Carolina Herbarium)*
Harper’s beauty (*Harperocallis flava*)
Federal Endangered
One of at several hundred Venus flytrap analogues, 1-3 yr fire obligates
(small forbs of wetland-upland habitats maintained in open sunny conditions by circumannual fire)

First tier 1-3 yrs, FL

Tier 2, Georgia aster, 3-5 yrs, NC, SC, Ga

Joan Walker, USFS
ENDANGERED

Golden Paintbrush

(Castilleja levisecta)

Federal Endangered

EXTIRPATED – Oregon
Mean Fire Interval

- 4.01 - 6
- 12.1 - 14
- 20.1 - 22
- 28.1 - 30
- 45.1 - 50
- 126 - 150
- 6.01 - 8
- 14.1 - 16
- 22.1 - 24
- 30.1 - 35
- 50.1 - 75
- 151 - 175
- < 2.01
- 8.01 - 10
- 16.1 - 18
- 24.1 - 26
- 35.1 - 40
- 75.1 - 100
- 176 - 200
- 2.01 - 4
- 10.1 - 12
- 18.1 - 20
- 26.1 - 28
- 40.1 - 45
- 101 - 125
- 201 - 6,360

Guyette, Stambaugh, Dey, Musica. 2012. Ecosystems
LF DDS – LANDFIRE Data Distribution Tool
https://landfire.gov/datatool.php
https://landfire.gov/viewer/
https://landfire.cr.usgs.gov/viewer

Use IE
Narrowing in
Kings Mountain Region - Historical Fire Regime and Fire Paths

<table>
<thead>
<tr>
<th>Fire Regime Class</th>
<th>Mean Fire Return Interval (years)</th>
<th>Dominant Species in the Fire Regime</th>
<th>Fire Regime Description</th>
<th>Area (acres)</th>
<th>Age of Landscape (percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>2.6</td>
<td>Oak, Hickory</td>
<td>High-intensity fire</td>
<td>6,096</td>
<td>41.1%</td>
</tr>
<tr>
<td>B</td>
<td>2.1</td>
<td>Oak, Hickory</td>
<td>Moderate-intensity fire</td>
<td>11,901</td>
<td>60.3%</td>
</tr>
<tr>
<td>C</td>
<td>1.10</td>
<td>Oak, Hickory</td>
<td>Low-intensity fire</td>
<td>42,365</td>
<td>75.5%</td>
</tr>
<tr>
<td>D</td>
<td>1.32</td>
<td>Oak, Hickory</td>
<td>Very low-intensity fire</td>
<td>23,033</td>
<td>35.6%</td>
</tr>
<tr>
<td>E</td>
<td>1.52</td>
<td>Oak, Hickory</td>
<td>Very low-intensity fire</td>
<td>3,394</td>
<td>66.2%</td>
</tr>
<tr>
<td>F</td>
<td>1.25</td>
<td>Oak, Hickory</td>
<td>Very low-intensity fire</td>
<td>22,396</td>
<td>37.1%</td>
</tr>
</tbody>
</table>

Legend:
- Red: Fire Path
- Green: Age of Landscape

Produced by Cecil Frost and Justin Shedd
December, 2015
Put fire back in → see what happens → adjust (adaptive mgmt)
Disturbance?

MFI ~ 5 yrs/50

MFI ~ 4 yrs/3

MFI ~ 6 yrs/42

MFI – 3 yrs/1
At least 2000 species in the eastern US are now found primarily on mowed roadsides and power line rights-of-way
Objectives for today

1. KNOW WHERE WE ARE GOING
   (given “the way things are”)

2. GET ON THE SAME PAGE
   about what we need to do with fire in the field in the next 10 years

Use Focused Fire

Restore Fire Integrity
**Definition:** The length of time for an area equal to the size of the study area to burn (long fire interval, mixed & high severity)

___James Agee 1993 From Miron “Bud” Heinselman’s work in the Boundary Waters area

Red – burned 4 times
Orange – 3 times
Green – twice
Blue – once
White – unburned in 200 years
100 year “fire rotations”

<table>
<thead>
<tr>
<th>SMOKEY BEAR NATIONAL FOREST, 100,000 acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000 a.</td>
</tr>
<tr>
<td>1000</td>
</tr>
<tr>
<td>1000</td>
</tr>
<tr>
<td>1000</td>
</tr>
<tr>
<td>1000</td>
</tr>
<tr>
<td>1000</td>
</tr>
<tr>
<td>1000</td>
</tr>
<tr>
<td>1000</td>
</tr>
<tr>
<td>1000</td>
</tr>
<tr>
<td>1000</td>
</tr>
</tbody>
</table>
Case 2: misinterpretation of “Fire Rotation”

<table>
<thead>
<tr>
<th>SMOKEY BEAR NATIONAL FOREST, <strong>500,000 acres, 100 burn units</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>5000</td>
</tr>
<tr>
<td>5000</td>
</tr>
<tr>
<td>5000</td>
</tr>
<tr>
<td>5000</td>
</tr>
<tr>
<td>5000</td>
</tr>
<tr>
<td>5000</td>
</tr>
<tr>
<td>5000</td>
</tr>
<tr>
<td>5000</td>
</tr>
<tr>
<td>5000</td>
</tr>
<tr>
<td>5000</td>
</tr>
<tr>
<td>5000</td>
</tr>
<tr>
<td>5000</td>
</tr>
<tr>
<td><strong>5000 a</strong></td>
</tr>
</tbody>
</table>

(an RxB plan for extinction!)
Put fire back in → see what happens → adjust (adaptive mgmt)
## PRESETTLEMENT FIRE FREQUENCIES – MAMMOTH CAVE REGION

<table>
<thead>
<tr>
<th>Fire Frequency Class</th>
<th>Mean Fire Interval (years)</th>
<th>Historic Range of Variation (years)</th>
<th>Original Vegetation</th>
<th>Acres</th>
<th>Acres burned annually</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>3</td>
<td>1-5</td>
<td>Karst plain &amp; ridgetop barrens</td>
<td>1226</td>
<td>408</td>
</tr>
<tr>
<td>B</td>
<td>4</td>
<td>2-6</td>
<td>Prairie-woodland mosaic</td>
<td>12223</td>
<td>3055</td>
</tr>
<tr>
<td>C</td>
<td>5</td>
<td>3-9</td>
<td>Pyrophytic woodland &amp; karst depression communities</td>
<td>13569</td>
<td>2713</td>
</tr>
<tr>
<td>D</td>
<td>6</td>
<td>4-12</td>
<td>Oak-hickory woodland</td>
<td>11128</td>
<td>1854</td>
</tr>
<tr>
<td>E</td>
<td>8</td>
<td>5-20</td>
<td>Understory fires in forest</td>
<td>6656</td>
<td>832</td>
</tr>
<tr>
<td>F</td>
<td>25</td>
<td>18-35+</td>
<td>Light fires in litter, to almost no fire in sheltered mesophytic forest</td>
<td>850</td>
<td>34</td>
</tr>
<tr>
<td>G</td>
<td>Infrequent</td>
<td>Variable</td>
<td>Steep, variably sheltered hardwood slopes</td>
<td>3011</td>
<td>n.a.</td>
</tr>
<tr>
<td>H</td>
<td>Sheltered from fire</td>
<td>Variable</td>
<td>Rare light fires in hardwood litter in alluvial bottoms</td>
<td>673</td>
<td>n.a.</td>
</tr>
<tr>
<td>I</td>
<td>5</td>
<td>1-10, Indians</td>
<td>Fire sheltered areas, with frequency increased by nearby resident Indians</td>
<td>1158</td>
<td>279</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td></td>
<td></td>
<td>****</td>
<td>50,494</td>
<td>9,478</td>
</tr>
</tbody>
</table>
The Inverted Pyramid

Field people lead, management follows
For the foreseeable future, any progress in restoring fire will be made from the bottom-up

*we are the leaders*

There are people and structure everywhere to facilitate actions we want to take

Interagency agreements are everywhere,
The Southern Fire Exchange
Regional Prescribed Fire Councils
Joint Fire Science Program
Regional Fire Science Consortiums
Fire Learning Networks
MOU’s between agencies like USFS, FWS, National Parks, BLM, BIA
Interagency MOU’s between state agencies

The people who are going to accomplish what needs to be done are those who jump in and work this system
Western Larch Savanna  *Larix occidentalis*
Camassia quamash
Nes Perce woman preparing winter’s supply of camas

Photo courtesy of the National Park Service, Nez Perce National Historical Park, Spalding, ID. Photo Number NEPE-HI-0773.)
CAMAS *Camassia quamash*
Beverly Skinner called a meeting of people together to get people excited about restoring the wetlands and they assembled $7 million and resources from 10 state and federal agencies, working together:
Montana DOT, NRCS, Flathead County Roads Dept., Federal Highways (a special grant opportunity), Corps of Engineers, Montana Dept of Natural Resources, Montana Fish, Wildlife & Parks, River Design and US Fish and Wildlife Service
KING FIRE
CA-NV, 97,717 acres
8002 personnel

El Dorado National Forest (596,000 a.)

July-Sep 2014
Star Gulch Fire 1996
Boise N.F.
Former Ponderosa Pine-Jeffrey Pine Savanna

*Pinus ponderosa-Pinus lambertiana*
STEP 1

Burn out the ridge tops
STEP 2

Burn out Jackpot Fuels

(100 tons/acre)
STEP 3, Spring

Burn the rest under moist conditions

Slowly – a series of light RxB
Special work around ancient remnant trees – gentle mechanical work and a series of light burns to slowly reduce fuel and prevent irdling

*Pinus ponderosa*-*Pinus lambertiana*
STEP 4
Drop everything up to 20 inches

STEP 5
Selectively girdle stems >20 inches to approximate original stand structure

STEP 6
Burn (Rx or lighting fire use) at 4-12 years, to approximate the original range of fire frequency
## The Future of Forest Restoration and Rx Fire?

<table>
<thead>
<tr>
<th>Incident Type</th>
<th>USFS Approval</th>
</tr>
</thead>
</table>
| **Type 1 Wildfire** | Regional Forester level with **National Oversight**  
Short Team, <2 weeks  
Long Team, incident >2 weeks *(team, 26 admin.)* |
| **Type 2 Wildfire** | Forest Supervisor level with oversight by the Regional Forester |
| **Type 3 Wildfire** | District Ranger level with oversight by the Forest Supervisor |
| **Type 3 Res/RxB** | **Standing Incident Command Team**  
for Forest Rescue & Restoration |
| **Types 4, 5** | |

Duane Nelson, District Ranger

“There are a thousand hacking at the branches of evil to one who is striking at the root”

Henry David Thoreau
For the foreseeable future, any progress in restoring fire integrity will be made from the bottom-up

**we are the leaders**