Characterizing fuels before and after prescribed fire in an Appalachian hardwood forest on the Cumberland Plateau, Kentucky

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INTRODUCTION

- A recognized decline in the advanced regeneration of oaks and an increase in fire sensitive species such as red maple (*Acer rubrum*) and American beech (*Fagus grandifolia*), may be due to a lack of fire.
- Prescribed fire is being applied to Appalachian hardwood forests in an attempt to alter forest structure and possibly promote oak regeneration.
- Very little information is available on fuel accumulation and consumption of fuels by prescribed fire in Appalachian hardwood forests.

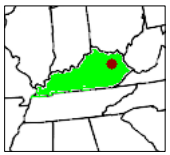
Goals

- **Evaluate forest floor fuels before and after a single prescribed fire.**
- **Evaluate the effect of landscape position on fuel accumulation and consumption by fire.**

METHODS

Study Description

- Sites were located on the Morehead District of the Daniel Boone National Forest in eastern KY.
- Three non-contiguous study sites (~120 ha each): Chestnut Cliff (CC), Buck Creek (BC), & Wolf Pen (WP)



Area of Kentucky in which study sites are located.

Topographic location of treatments and plot.

- Fuel measurements were made before and after single prescribed fires.
- Analyzed using repeated measures for a split-plot design with landscape position as a variable (PROC MIXED, SAS Institute 2000).

Woody fuels

- Woody fuels were measured using Brown's planar intercept transect technique (Brown 1974).
- Four size classes were measured: 1Hr (0 - 0.6 cm), 10 Hr (0.6 - 2.5 cm), 100 Hr (2.5 – 7.6 cm), and 1000 Hr (≥7.6 cm)
- Two transects were sampled per plot; 62 plots total.

Recently sampled forest floor block.

Forest floor

- Litter layer (Oi) was collected separately from fermentation and humus layers, or duff (Oea), using a 30 X 30 cm template.
- Four samples were taken per plot; 62 plots total.

Fire Treatments

- Prescribed fires were conducted by Forest Service personnel in March – April 2003.

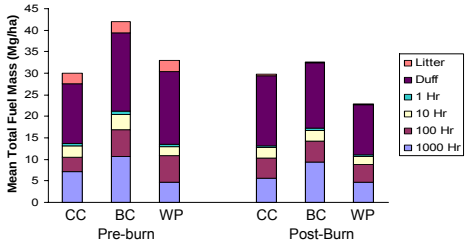
Day-of-Burn Statistics

	CC (F) 3/24/03		CC (LF) 3/25/03		BC 4/14/03		WP 4/16/03	
Burn	Start	End	Start	End	Start	End	Start	End
Ignition time	12:34	16:30	11:30	14:00	11:00	17:00	12:30	17:10
Temp. °C	24	25	26	24	22	27	28	28
RH %	39	31	31	34	36	23	36	38
Wind (mph)	0-6	2-5	2-7	0-2	0	0-4	3-4	3-6

Landscape Position

- Plots were categorized into landscape positions based on aspect, slope position, hill-shading, and species composition.
- Three categories: xeric, intermediate, and mesic

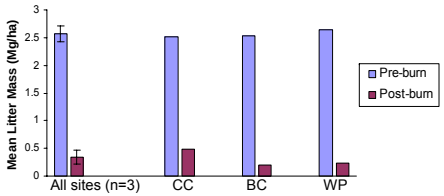
How does the mass of the fuel load compare by component? (e.g. leaf litter, duff, woody fuels)



- Mean fuel load was reduced by fire and ranged from 30 to 42 Mg/ha pre-burn, and from 23 to 33 Mg/ha post-burn.
- Duff (Oea) was the most massive component of the fuel load.

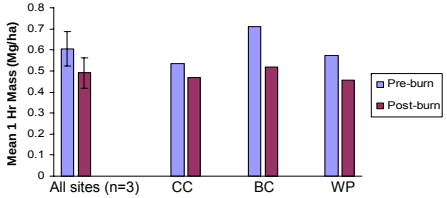
Which fuels were consumed by fire?

Litter mass



- Leaf litter was significantly reduced by prescribed fire. ($p < 0.0001$)
- While some of this reduction was due to decomposition (control site data not shown), most was due to consumption by fire.

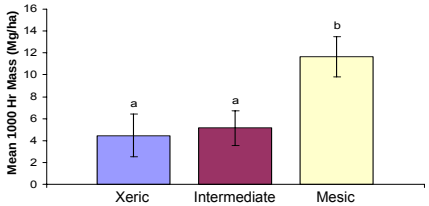
1 hr woody fuels



- One hour woody fuels were also significantly reduced by prescribed fire. ($p < 0.01$)
- No other fuels were significantly reduced by fire.

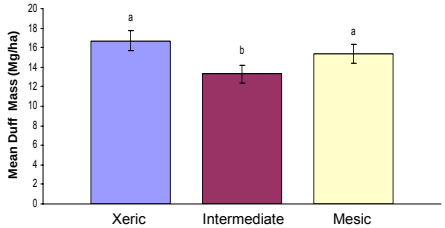
Which fuels vary by landscape position?

1000 hr woody fuels



- The mesic plots had higher 1000 hour fuel mass than the xeric ($p<0.01$) and intermediate ($p<0.01$) plots.

Duff (Oea) mass



- The intermediate plots had less duff than the xeric ($p=0.002$) and the mesic ($p=0.05$) plots.
- No other fuels varied significantly by landscape position.

CONCLUSIONS

- Litter and 1 hr woody fuels were the only components of the fuel load that were reduced by prescribed fire.
- Duff and 1000 hr woody fuels were the only components of the fuel load that were affected by landscape position.
- Thus, landscape position did not affect the accumulation of combustible fuels on our study sites.
- Leaf litter and 1 hr woody fuels are the fastest drying fuels and most combustible fuels, yet they comprise the least mass.

QUESTIONS

- It has been suggested that the litter of some deciduous tree species, such as oaks, are more flammable than others, such as maples. **Does the percentage or the mass of oak litter effect burn intensity?** Future analysis will address this question.
- **How will tree dieback and mortality affect fuel loads in the future?**

LITERATURE CITED

Brown, J. K. 1974. Handbook for inventorying downed woody material. USDA Forest Service, GTR-INT-16

SAS Institute. 2000. SAS Procedures Guide, Version 8. SAS Institute, Inc. Cary N.C.

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