Altered Fire Behavior & Effects Following Mastication in Pine Flatwoods Ecosystems

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INTRODUCTION

Mastication of shrubs and small trees is a widespread fuels treatment aimed at mitigating fire hazard. Few field studies, however, have evaluated the efficacy of these treatments to alter fire behavior or subsequent fire effects, especially in the southeastern USA.

Objectives:

1. **Determine whether mastication of palm-dominated understories in pine flatwoods ecosystems alters subsequent fire behavior and fire effects.**
2. **Quantify post-fire tree mortality following prescribed burning in treated (masticated) and untreated stands .**

METHODS

Study Site

Mature longleaf pine flatwoods with a palmetto-gallberry shrub understory in Osceola N.F. (Florida)

2 TREATMENT LOCATIONS

- Buffer:. Mowing was conducted to create a fuelbreak in Aug 2009 and subsequently burned in the summer (July) 2010.
- Exp. Blocks: Mowing and burning was conducted in three experimental blocks to create the following 2-ha treatments in each block: mow (M), mow+burn (M+B), burn only (B), control (C). Mowed: Aug 2010, burned: winter (Feb) 2011.

Sampling and Data Analysis

- 27 plots were established: 9 in Buffer (M+B) and 3 per burn treatment (B, M+B) per block in the Exp. Blocks.
- Fuels and vegetation were quantified prior to burning and day-of-burn conditions were recorded (Table 1)
- Fire behavior and fire effects were quantified at the plot-level and tree mortality assessed 1 yr following burning.
- Fire behavior and effects were compared across burn treatments: winter B & M+B (Blocks) & summer M+B (Buffer).
- Fire behavior metrics were regressed against shrub cover & height as well as surface litter mass.
- Tree mortality was compared across all burn treatments.

RESULTS

METHODS cont.

Table 1. Weather, overstory, and fuels during winter (Feb) burning in mowed (Mow+Burn) and unmowed (Burn Only) palmetto -gallberry pine flatwoods and summer burning (July) in mowed (Mow+Burn) palmetto/gallberry pine flatwoods.

	Burning Conditions							
	Burn Date	Temp	RH	Windspeed	Litter	Live	10h	KBDI
		˚C	*%*	*km·hr⁻¹*	*----------% moisture----------*			
Burn Only (W)	23 Feb 2011	17-24	47-62	1.6-4.8	12.1 (0.6)^{A}	117 (3)^{A}	20.9 (6.6)^{A}	107
Mow+Burn (W)					17.8 (2.4)^{B}	110 (3)^{A}	27.8 (5.6)^{A}	107
Mow+Burn (S)	28 Jul 2010	31-34	61-76	1.6-7.2	14.7 (1.1)^{B}			425
	Overstory							
	Tree Density	Basal Area	QMD	Height	CBH			
	trees·ha⁻¹	*m²·ha⁻¹*	*cm*	*m*	*m*			
Burn Only (W)	365 (63)^{A}	15.2 (1.7)^{A}	23.9 (1.9)^{A}	20.7 (1.6)^{A}	15.1 (1.1)^{A}			
Mow+Burn (W)	307 (64)^{A}	18.9 (4.4)^{A}	27.8 (1.6)^{A}	21.0 (0.7)^{A}	14.7 (0.9)^{A}			
Mow+Burn (S)	290 (27)^{A}	23.1 (3.0)^{A}	32.0 (2.6)^{A}	23.3 (0.9)^{A}	15.8 (0.8)^{A}			
	Understory Fuels							
	Shrub Cover[1]	Shrub Height[1]	Shrubs	Shrub Foliage				
	%	*cm*	*----------Mg·ha⁻¹----------*					
Burn Only (W)	77.5 (4.0)^{B}	145 (8)^{B}	4.4 (0.5)^{B}	4.1 (0.5)^{B}				
Mow+Burn (W)	32.5 (3.6)^{A}	58 (13)^{A}	0.6 (0.3)^{A}	0.4 (0.2)^{A}				
Mow+Burn (S)		69 (7)^{A}	0.9 (0.5)^{A}	0.5 (0.2)^{A}				
	Surface Fuels							
	Litter Depth	Duff Depth	Litter	Duff	1 h	10 h	100 h	
	----------cm----------			*----------Mg·ha⁻¹----------*				
Burn Only (W)	7.6 (0.2)^{B}	4.5 (0.7)^{A}	8.8 (0.3)^{B}	49.5 (7.4)^{A}	0.5 (0.1)^{B}	1.1 (0.4)^{A}	0.7 (0.3)^{A}	
Mow+Burn (W)	5.7 (0.4)^{A}	3.0 (0.5)^{A}	12.8 (1.0)^{A}	33.6 (5.5)^{A}	1.1 (0.2)^{A}	2.1 (0.3)^{A}	1.1 (0.6)^{A}	
Mow+Burn (S)	4.9 (0.7)^{A}	5.3 (0.8)^{A}	10.9 (1.6)^{A}	58.8 (9.4)^{A}	4.1 (1.0)^{A}	6.6 (0.6)^{A}	2.5 (1.1)^{A}	

Table 2. Fire behavior and effects from winter (Feb) burning in mowed (Mow+Burn) and unmowed (Burn Only) palmetto -gallberry pine flatwoods and summer burning (July) in mowed (Mow+Burn) palmetto/gallberry pine flatwoods.

	Fire Behavior		**Consumption**				**Overstory Fire Effects**		
	Flame Ht	ROS	Litter	Duff	Litter	Duff	Scorch	Char	Char Height
	m	*m·min⁻¹*	*-------Mg·ha⁻¹---------*		*-------%-------*		*%*	*%*	*m*
Winter									
Burn Only	3.3 (0.5)^{B}	7.1 (2.1)^{A}	7.6(0.8)^{AB}	1.1 (1.1)^{A}	86 (8)^{A}	3 (3)^{A}	53 (6)^{A}	97 (2)^{A}	7.4 (0.9)^{A}
Mow+Burn	1.1 (0.3)^{A}	3.4 (1.0)^{A}	10.6 (0.8)^{A}	0.0 (0.0)^{A}	83 (4)^{A}	0 (0)^{A}	37 (8)^{A}	86 (6)^{AB}	5.5 (0.6)^{AB}
Summer									
Mow+Burn	1.5 (0.1)^{A}	5.9 (1.8)^{A}	5.5 (1.3)^{B}	23.1 (10.1)	48 (7)^{B}	32 (11)^{B}	25 (11)^{A}	64 (9)^{B}	4.7 (0.6)^{B}

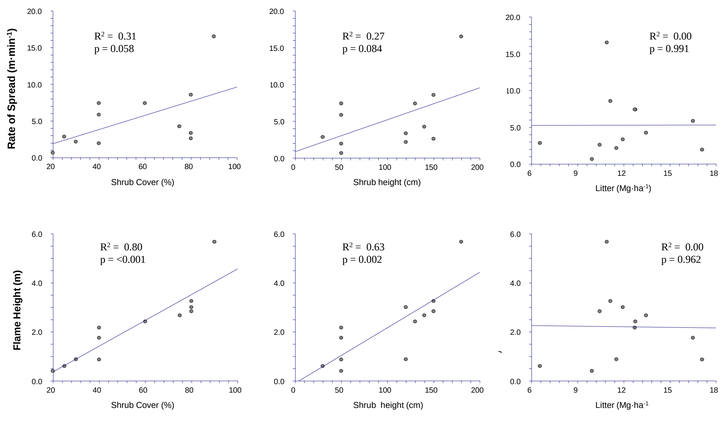

Figure 1. Fire behavior measurements (rate of spread, above; flame height, below) as a function of shrub cover (left), shrub height (middle), and litter mass (right) during the burning of mowed and un-mowed experimental treatments in pine flatwoods.

RESULTS cont.

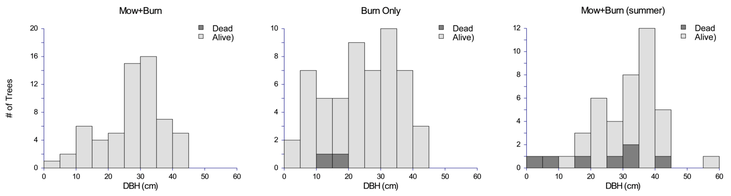

Figure 2. Tree mortality within diameter distributions across Mow+Burn (left) and Burn Only (middle) treatments burned in the winter (Feb) and Mow+Burn treatments burned in the summer (July) (right).

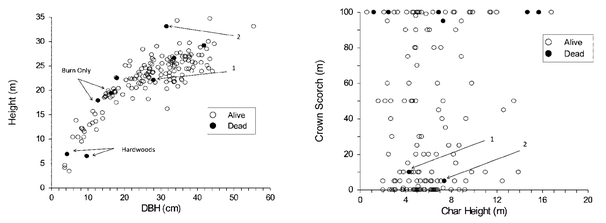

Figure 3. Tree mortality across tree characteristics (left) and tree injury (right) of all trees examined in this study. The height vs DBH graph indicates the only 2 hardwoods in the study (both died) and the only 2 trees that died in the burn only treatment, all other dead trees occurred in the masticated treatment burned in the summer. Trees 1 and 2 are indicated in both graphs and were both large trees with little crown scorch that died following summer burning following mowing.

Results & Discussion

- Fire behavior was subdued by mowing, but flame heights were correlated with shrub cover across all treatments, likely due to rapid shrub recovery following their mastication.
- Mature pines recovered from injury, including substantial crown scorch, following winter burning in both mowed and unmowed stands, however some mortality occurred when mowed stands were burned in the summer.
- Litter consumption was higher during winter burns, but duff consumption was greater during summer burns.

CONCLUSIONS

Mastication of palmetto-gallberry understories in mature pine flatwoods reduces fire behavior, a primary goal of treatments, however rapid shrub recovery in this ecosystem suggests a limited window of effectiveness.

Tree mortality evidenced after summer burning may have resulted from root or basal injury associate with duff consumption, but is unclear from this study.

The timing and conditions of follow-up burning will be critical to the efficacy of mastication fuels treatments.

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