

Supplementary material

Fuel dynamics during oak woodland and savanna restoration in the Mid-South USA

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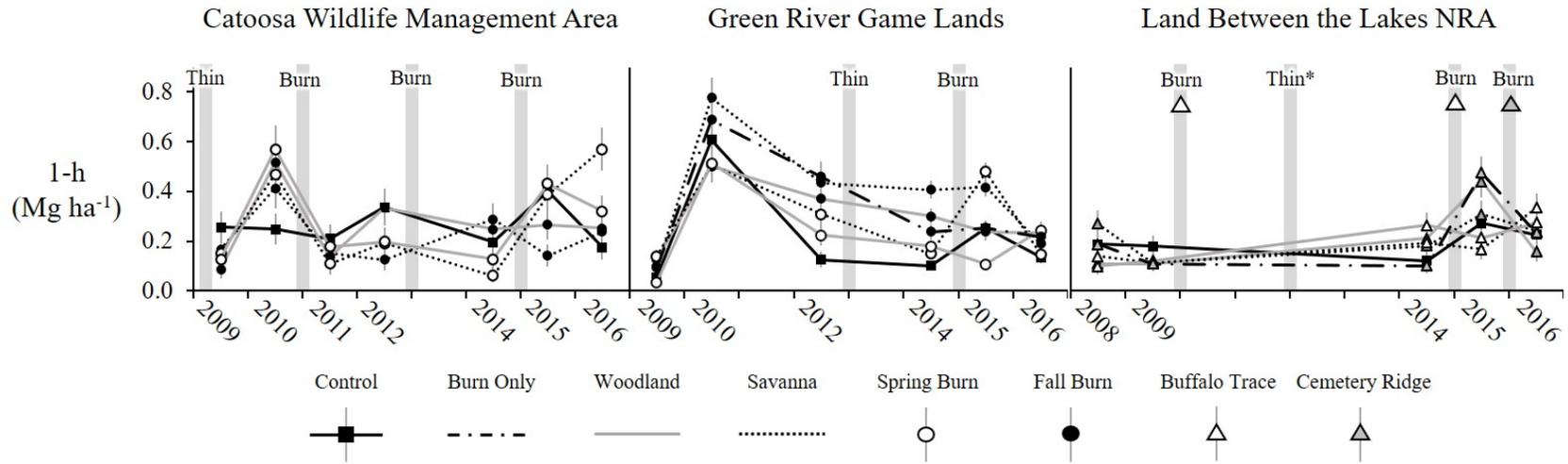


Fig. S1. Dynamics in 1-h fuels by oak woodland and savanna restoration treatment at three sites from 2008 to 2016. Treatments included unmanaged controls, burn-only in the fall (October) or spring (March), and fall or spring fire paired with woodland ($14 \text{ m}^2 \text{ ha}^{-1}$) or savanna ($7 \text{ m}^2 \text{ ha}^{-1}$) residual basal area. All fires at Land Between the Lakes (LBL) were conducted in the spring, but timing differed between two sites: Buffalo Trace (March) and Cemetery Ridge (April). For LBL and Catoosa, each treatment line represents two 20-ha replicates. Green River had one 20-ha replicate per treatment. *Thinning at LBL occurred over a 3-year period (Fig. 1).

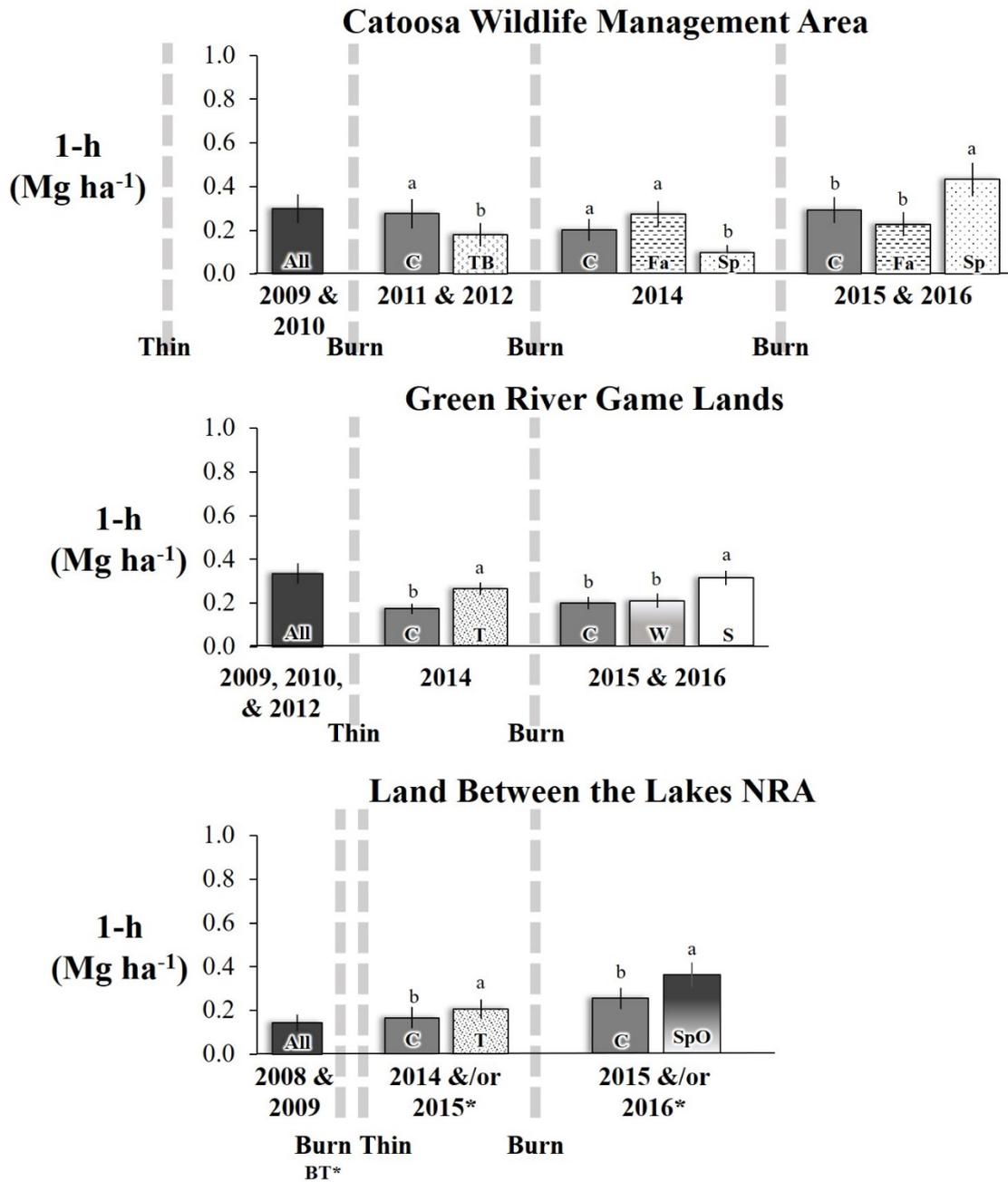


Fig. S2. All significant ($\alpha = 0.05$) differences in 1-h fuel loads across treatments during (2008 to 2016) oak woodland and savanna restoration experiments at three sites across the Mid-South. Lowercase letters represent differences within a period as indicated by contrasts between stands that were unmanaged or thinned (C vs. T), unmanaged or burned only in the spring (C vs. SpO) or fall (C vs. FaO), unmanaged or thinned and burned (C vs. TB), reduced to woodland ($14 \text{ m}^2 \text{ ha}^{-1}$) or savanna ($7 \text{ m}^2 \text{ ha}^{-1}$) residual basal area (W vs. S), burned in the fall or spring (Fa vs. Sp), and burned in separate spring fires (BT vs. CR). Additional contrasts as needed (e.g., C vs. S or SpO vs. W) fully distinguished treatment differences. When no differences were observed, the overall mean in presented (All). *Only the Buffalo Trace (BT) site was burned in 2009, and 2014 to 2016 data were compiled as indicated to compare burns not conducted within the same year.

Table S1. Differences ($\alpha = 0.05$) in woody (1000-h, 100-h, 10-h, 1-h and litter) and herbaceous fuel loads during (2008 to 2016) oak woodland and savanna restoration experiments at three sites in the Mid-South.

Treatment contrasts compared stands that were: unmanaged or thinned (C vs. T), unmanaged or only burned in the fall (C vs. FaO) or spring (C vs. SpO), unmanaged or thinned and burned (C vs. TB), reduced to woodland ($14 \text{ m}^2 \text{ ha}^{-1}$) or savanna ($7 \text{ m}^2 \text{ ha}^{-1}$) residual basal area (W vs. S), burned in the fall or spring (Fa vs. Sp), and burned in separate spring fires (BT vs. CR). Additional contrasts as needed (*e.g.*, C vs. S or SpO vs. W) fully distinguished treatment differences. Except for C vs. T, which was always tested, contrast evaluation followed the implementation of involved management.

Site	Fuel category	Period	Year(s) ¹	Contrast	<i>F</i>	<i>p</i>	Estimate ¹ Mg ha ⁻¹ (SE)
Catoosa WMA	1000-h	Post-thin	2009 & 2010	C vs. T	16.0	0.003	+16.4 (4.7)
		Post-burn 1	2011 & 2012	C vs. TB	27.8	< 0.001	+32.1 (6.7)
				W vs. S	6.6	0.028	-18.0 (6.0)
				C vs. S	14.6	0.004	+23.1 (7.4)
	100-h	Post-burn 2	2014	C vs. TB	11.8	0.018	+16.1 (5.0)
		Post-burn 3	2015 & 2016	C vs. TB	25.6	0.001	+15.6 (3.5)
		Post-burn 1	2011 & 2012	Fa vs. Sp	7.6	0.020	+2.3 (0.9)
				W vs. S	9.9	0.011	-2.0 (0.6)
					C vs. W	9.4	0.013
		10-h	Post-thin	2009 & 2010	C vs. T	6.1	0.033
	Post-burn 1		2011 & 2012	W vs. S	6.6	0.028	-0.7 (0.2)
	Post-burn 3		2015 & 2016	Fa vs. Sp	5.3	0.045	+0.9 (0.4)
	1-h	Post-burn 1	2011 & 2012	C vs. TB	6.3	0.031	-0.09 (0.04)
		Post-burn 2	2014	Fa vs. Sp	18.9	0.007	-0.18 (0.05)
		Post-burn 3	2015 & 2016	Fa vs. Sp	16.7	0.002	+0.19 (0.04)
	1-h and litter	Post-thin	2009 & 2010	C vs. T	20.8	0.001	-1.2 (0.2)
				C vs. TB	103.3	< 0.001	-3.2 (0.3)
		Post-burn 1	2011 & 2012	Fa vs. Sp	8.5	0.015	-0.7 (0.3)
				C vs. TB	10.1	0.025	-2.4 (0.8)
				C vs. TB	11.6	0.007	-1.8 (0.5)
		Post-burn 2	2014	W vs. S	7.9	0.018	-1.2 (0.4)
				C vs. TB	10.8	0.022	+0.3 (0.2)
	Herbaceous*	Post-burn 2	2014	W vs. S	14.1	0.013	+0.4 (0.1)
C vs. TB				46.9	< 0.001	+0.3 (0.1)	
Post-burn 3		2015 & 2016	W vs. S	19.7	0.001	+0.2 (0.1)	

Green River Game Lands	1000-h	Post-thin	2014	C vs. T	18.5	< 0.001	+16.8 (5.1)			
				W vs. S	7.2	0.009	-15.3 (5.9)			
				C vs. S	6.5	0.013	+11.1 (7.1)			
		Post-burn	2015 & 2016	C vs. TB	4.6	0.034	+6.6 (3.1)			
				W vs. S	5.8	0.018	+7.1 (2.9)			
				C vs. T	25.7	< 0.001	+5.4 (1.2)			
	100-h	Post-thin	2014	W vs. S	15.5	< 0.001	+5.6 (1.4)			
				C vs. W	13.7	< 0.001	+4.5 (1.7)			
				W vs. S	7.9	0.006	+1.6 (0.7)			
	10-h	Post-burn	2015 & 2016	C vs. T	11.2	0.001	+0.8 (0.3)			
		Post-thin	2014	C vs. TB	4.2	0.042	+0.6 (0.2)			
		Post-burn	2015 & 2016	W vs. S	30.5	< 0.001	+1.3 (0.2)			
	1-h	Post-thin	2014	C vs. T	23.6	< 0.001	+0.09 (0.02)			
				Post-burn	2015 & 2016	C vs. TB	6.7	0.011	+0.07 (0.02)	
						W vs. S	19.2	< 0.001	+0.11 (0.02)	
	1-h and litter	Post-thin	2014	C vs. T	100.5	< 0.001	-2.6 (0.2)			
				W vs. S	6.4	0.014	-0.7 (0.3)			
				C vs. W	50.0	< 0.001	-2.7 (0.3)			
		Post-burn	2015 & 2016	C vs. FaO	14.9	< 0.001	-1.4 (0.3)			
				C vs. TB	115.6	< 0.001	-2.8 (0.3)			
C vs. W				47.0	< 0.001	-2.2 (0.3)				
W vs. S				39.6	< 0.001	-1.3 (0.2)				
Fa vs. Sp				4.5	0.036	+0.3 (0.2)				
FaO vs. W				7.1	0.009	-0.7 (0.3)				
C vs. T				35.0	< 0.001	+0.4 (0.1)				
Herbaceous*	Post-thin	2014	C vs. TB	171.6	< 0.001	+0.5 (0.1)				
	Post-burn	2015 & 2016	W vs. S	94.9	< 0.001	+0.7 (0.1)				
			Fa vs. Sp	18.2	< 0.001	+0.2 (0.1)				
Land Between the Lakes	1000-h	Post-thin	2014 &/or 2015*	C vs. T	28.6	< 0.001	+15.4 (3.9)			
				C vs. TB	14.5	0.003	+7.1 (3.5)			
				T vs. TB	9.6	0.021	-11.9 (3.7)			
	100-h	Post-thin	2014 &/or 2015*	C vs. T	5.4	0.039	+3.8 (1.4)			
				10-h	Post-thin	2014 &/or 2015*	C vs. T	6.2	0.028	+1.0 (0.4)
							Post-burn	2015 &/or 2016*	C vs. TB	10.4
	BT vs. CR	7.0	0.039	-0.3 (0.1)						
	1-h	Post-thin	2014 &/or 2015*	C vs. T	11.7	0.005			+0.16 (0.04)	
				Post-burn	2015 &/or 2016*	C vs. SpO	16.4	0.007	+0.12 (0.03)	
	1-h and litter	Post-burn	2015 &/or 2016*	C vs. SpO	36.7	0.001	-1.4 (0.2)			
				C vs. TB	309.0	< 0.001	-2.8 (0.2)			

			W vs. S	48.0	< 0.001	-0.6 (0.2)
			BT vs. CR	131.1	< 0.001	+1.4 (0.2)
Herbaceous*	Post-thin	2014 &/or 2015*	SpO vs. W	32.1	0.001	-1.1 (0.2)
			C vs. T	18.8	0.005	+0.1 (0.0)
	Post-burn	2015 &/or 2016*	C vs. TB	25.0	0.003	+0.1 (0.0)
			C vs. SpO	88.8	< 0.001	+0.3 (0.0)
			C vs. TB	208.7	< 0.001	+0.4 (0.0)
			BT vs. CR	22.9	0.003	-0.2 (0.0)

¹Estimates given in terms of the second treatment relative to the first within contrast labels.

*Data from 2014 to 2016 at Land Between the Lakes were compiled as indicated to allow for contrasts among fires not conducted within the same year. Herbaceous fuels only monitored 2014-2016.

Table S2. Interactions ($\alpha = 0.05$) between treatment and year effects on woody (1000-h, 100-h, 10-h, 1-h and litter) and herbaceous fuel loads during (2008 to 2016) oak woodland and savanna restoration experiments at three sites in the Mid-South

Interaction contrasts compared changes in fuel loading across all available year intervals between: unmanaged or thinned (C vs. T), unmanaged or only burned in the fall (C vs. FaO) or spring (C vs. SpO), unmanaged or thinned and burned (C vs. TB), reduced to woodland (14 m² ha⁻¹) or savanna (7 m² ha⁻¹) residual basal area (W vs. S), burned in the fall or spring (Fa vs. Sp), and burned in separate spring fires (SpBT vs. SpCR). C vs. T was always tested, but other contrasts followed the implementation of involved management.

Site	Fuel category	Period	Interval ¹	Contrast	<i>F</i>	<i>p</i>	Estimate ¹ Mg ha ⁻¹ (SE)	
Catoosa WMA	1000-h	Pre- to post- burn 1	2010 to 2011	W vs. S	5.0	0.031	+26.3 (9.6)	
	100-h	Pre- to post- burn 1	2010 to 2011	Fa vs. Sp	6.4	0.016	+9.3 (3.8)	
	10-h	-	-	-	-	-	-	
	1-h	Pre- to pre- thin	2009 to 2010	C vs. T	12.3	0.001	+0.35 (0.10)	
		Pre- to post- burn 1	2010 to 2011	C vs. TB	7.9	0.008	-0.31 (0.10)	
		Pre- to post- burn 2	2012 to 2014	Fa vs. Sp	5.0	0.033	-0.14 (0.09)	
		Pre- to post- burn 3	2014 to 2015	Fa vs. Sp	25.1	< 0.001	+0.38 (0.08)	
		1 to 2 years post- burn 3	2015 to 2016	C vs. TB	7.6	0.009	+0.26 (0.09)	
					W vs. S	4.7	0.038	-0.19 (0.08)
	1-h and litter	Pre- to post- burn 1	2010 to 2011	C vs. TB	8.2	0.007	-2.3 (0.9)	
Herbaceous*	Pre- to post- burn 3	2014 to 2015	Fa vs. Sp	6.2	0.025	+0.4 (0.1)		
Green River Game Lands	1000-h	Pre- to post- burn	2014 to 2015	W vs. S	7.4	0.007	-20.6 (6.4)	
	100-h	Pre- to pre- thin	2009 to 2010	C vs. T	9.3	0.003	-9.1 (2.2)	
		Pre- to pre- thin	2010 to 2012	C vs. T	6.6	0.010	+7.2 (2.3)	
		Pre- to post- burn	2014 to 2015	C vs. TB	5.4	0.021	-6.0 (1.9)	
	10-h	Pre- to pre- thin	2009 to 2010	C vs. T	5.7	0.018	-1.4 (0.6)	
		Pre- to post- thin	2012 to 2014	C vs. T	4.3	0.039	+1.0 (0.6)	
		Pre- to post- burn	2014 to 2015	C vs. FaO	4.1	0.045	-1.1 (0.7)	
				W vs. S	13.5	< 0.001	-1.9 (0.5)	
		1 to 2 years post- burn	2015 to 2016	W vs. S	13.5	< 0.001	+2.3 (0.6)	
	1-h	Pre- to pre- thin	2010 to 2012	C vs. T	3.9	0.049	+0.10 (0.06)	
		Pre- to post- burn	2014 to 2015	C vs. FaO	8.4	0.004	-0.13 (0.06)	
				C vs. TB	10.6	0.001	-0.11 (0.05)	
				W vs. S	32.2	< 0.001	-0.25 (0.05)	
			Fa vs. Sp	9.9	0.002	+0.14 (0.05)		

	1-h and litter	1 to 2 years post- burn	2015 to 2016	W vs. S	49.8	< 0.001	+0.34 (0.05)
		Pre- to post- thin	2012 to 2014	C vs. T	25.5	< 0.001	-2.3 (0.5)
		Pre- to post- burn	2014 to 2015	C vs. FaO	5.3	0.022	-1.5 (0.6)
		1 to 2 years post- burn	2015 to 2016	C vs. FaO	5.8	0.017	+1.7 (0.7)
				C vs. TB	7.5	0.007	+1.1 (0.5)
	Herbaceous*	Pre- to post- burn	2014 to 2015	W vs. S	10.0	0.002	+1.7 (0.5)
				W vs. S	6.2	0.014	+0.3 (0.1)
				Fa vs. Sp	22.2	< 0.001	+0.5 (0.1)
		1 to 2 years post- burn	2015 to 2016	C vs. TB	9.1	0.003	+0.5 (0.2)
				W vs. S	12.4	0.001	+0.7 (0.1)
Land Between the Lakes	1000-h	Pre- to post- thin	2009 to 2014	C vs. T	7.0	0.013	+17.2 (6.1)
				-	-	-	-
	100-h	Pre- to post- thin	2009 to 2014	C vs. T	5.9	0.021	+1.8 (0.6)
				Pre- to post- burn	2014/2015 to 2015/2016*	C vs. TB	9.5
	10-h	Pre- to post- thin	2009 to 2014	BT vs. CR	5.8	0.023	+0.9 (0.5)
				C vs. T	7.7	0.009	+0.14 (0.05)
	1-h	Pre- to post- thin	2009 to 2014	C vs. TB	6.7	0.015	+0.16 (0.06)
				Pre- to post- burn	2014/2015 to 2015/2016*	C vs. SpO	7.1
	1-h and litter	Pre- to post- burn	2014/2015 to 2015/2016*	C vs. TB	33.9	< 0.001	-2.7 (0.6)
				BT vs. CR	7.6	0.010	-0.4 (0.7)
Herbaceous*	Pre- to post- burn	2014/2015 to 2015/2016*	C vs. SpO	30.1	< 0.001	+0.3 (0.1)	
			C vs. TB	40.7	< 0.001	+0.2 (0.0)	

¹Estimates given in terms of the second treatment relative to the first within contrast label. *Data from 2014 to 2016 at Land Between the Lakes were compiled as indicated to allow for contrasts among fires not conducted within the same year. Herbaceous fuels only monitored 2014-2016.