Mechanical fuels reduction treatments effects on fire behavior, fuel loads, and forest ecology

Osceola National Forest

Sept. 28th, 2011

Sponsors: Conserved Forest Ecosystems Outreach and Research (CFEOR); Southern Fire Exchange (SFE: www.southernfirexchange.org); Joint Fire Science Program; US Forest Service; University of Florida Fire Science Lab

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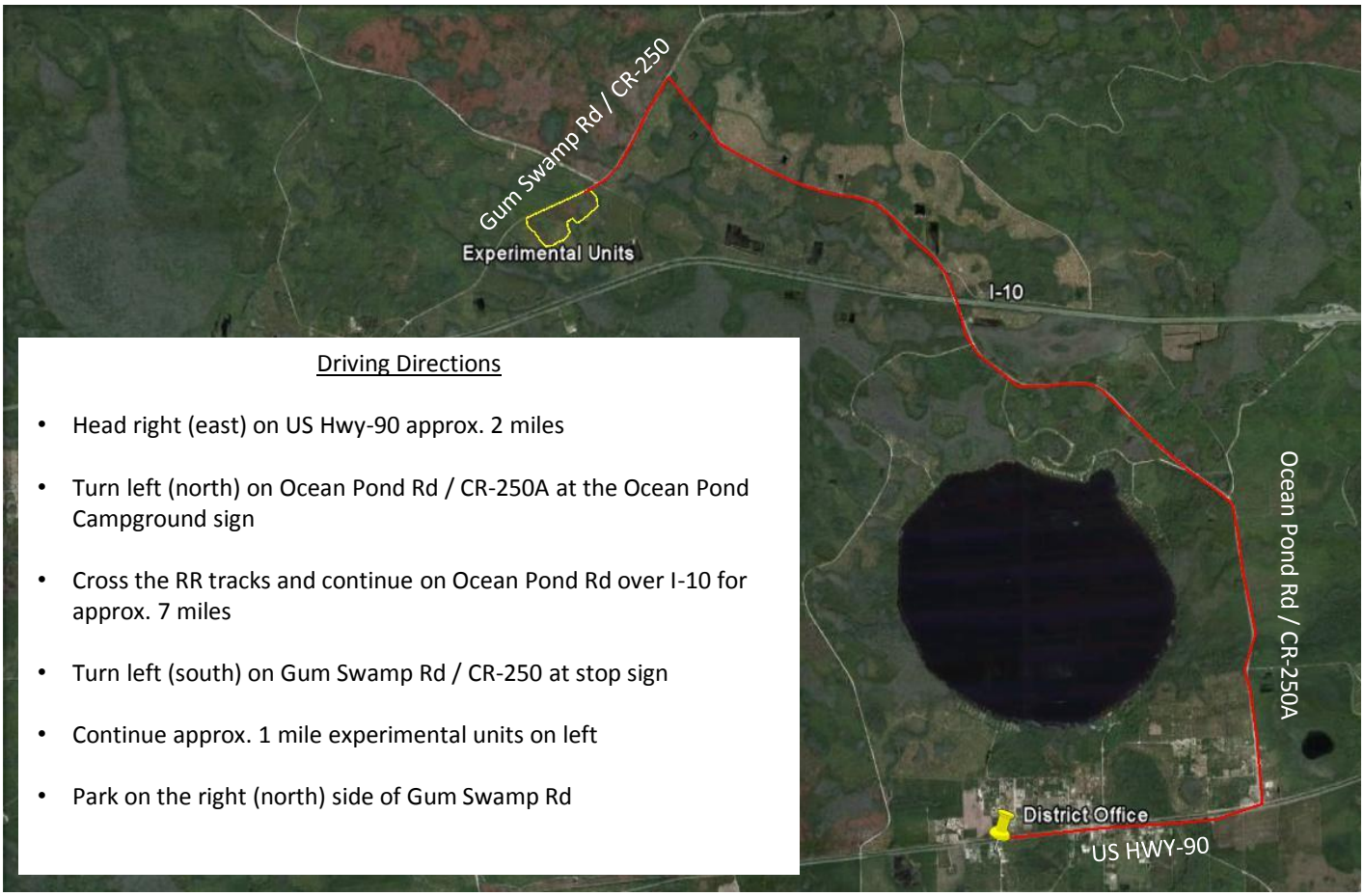
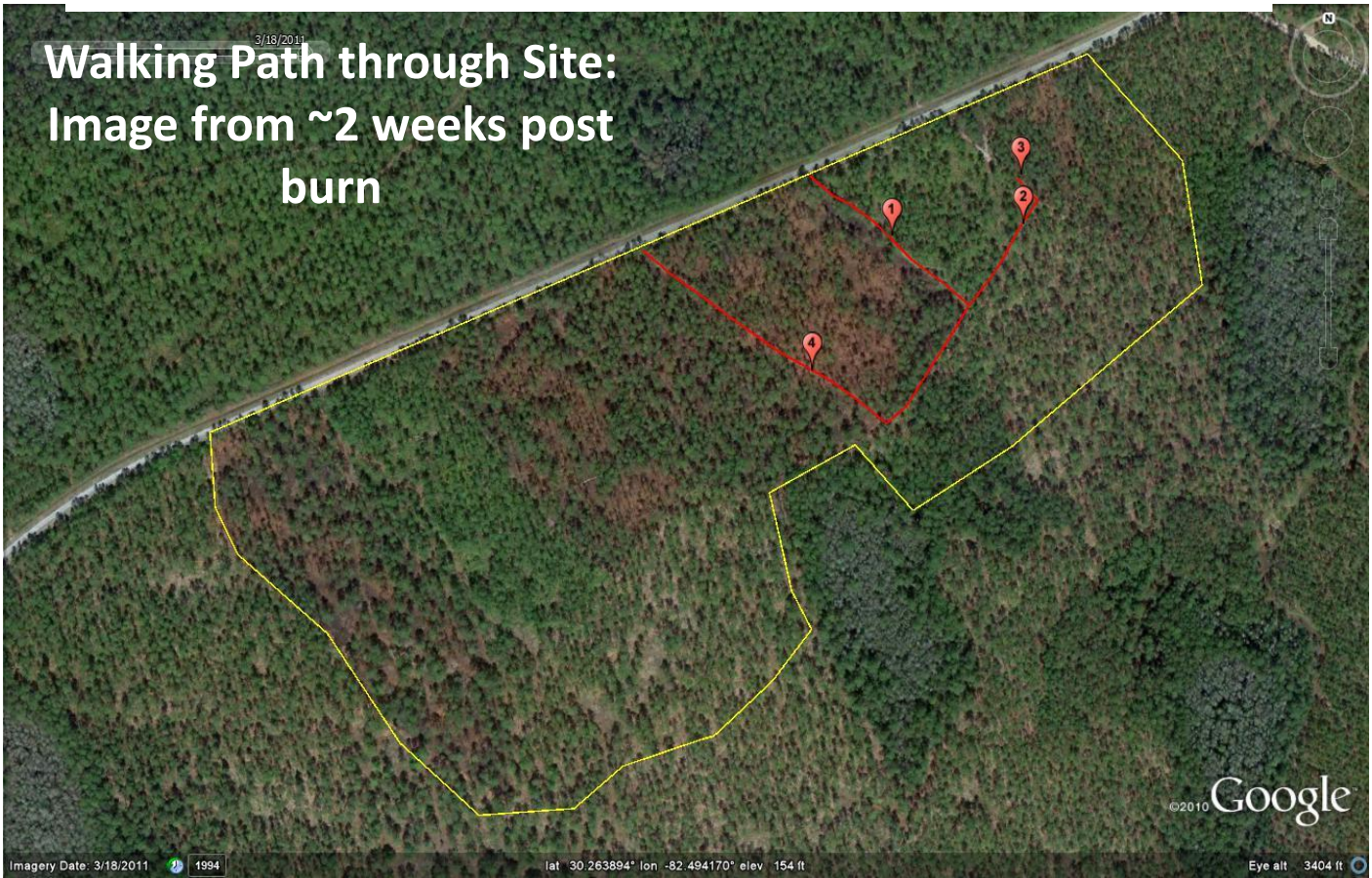


Driving Directions

- Head right (east) on US Hwy-90 approx. 2 miles
- Turn left (north) on Ocean Pond Rd / CR-250A at the Ocean Pond Campground sign
- Cross the RR tracks and continue on Ocean Pond Rd over I-10 for approx. 7 miles
- Turn left (south) on Gum Swamp Rd / CR-250 at stop sign
- Continue approx. 1 mile experimental units on left
- Park on the right (north) side of Gum Swamp Rd

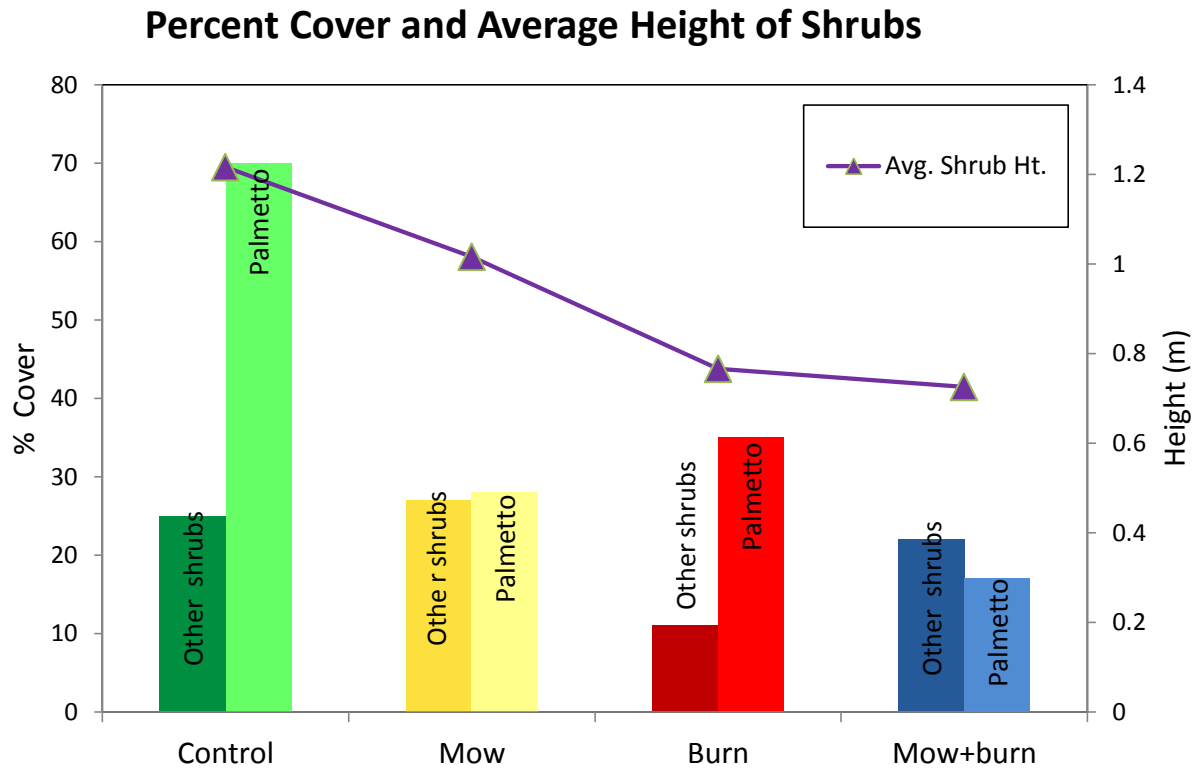
Map of Treatment Locations

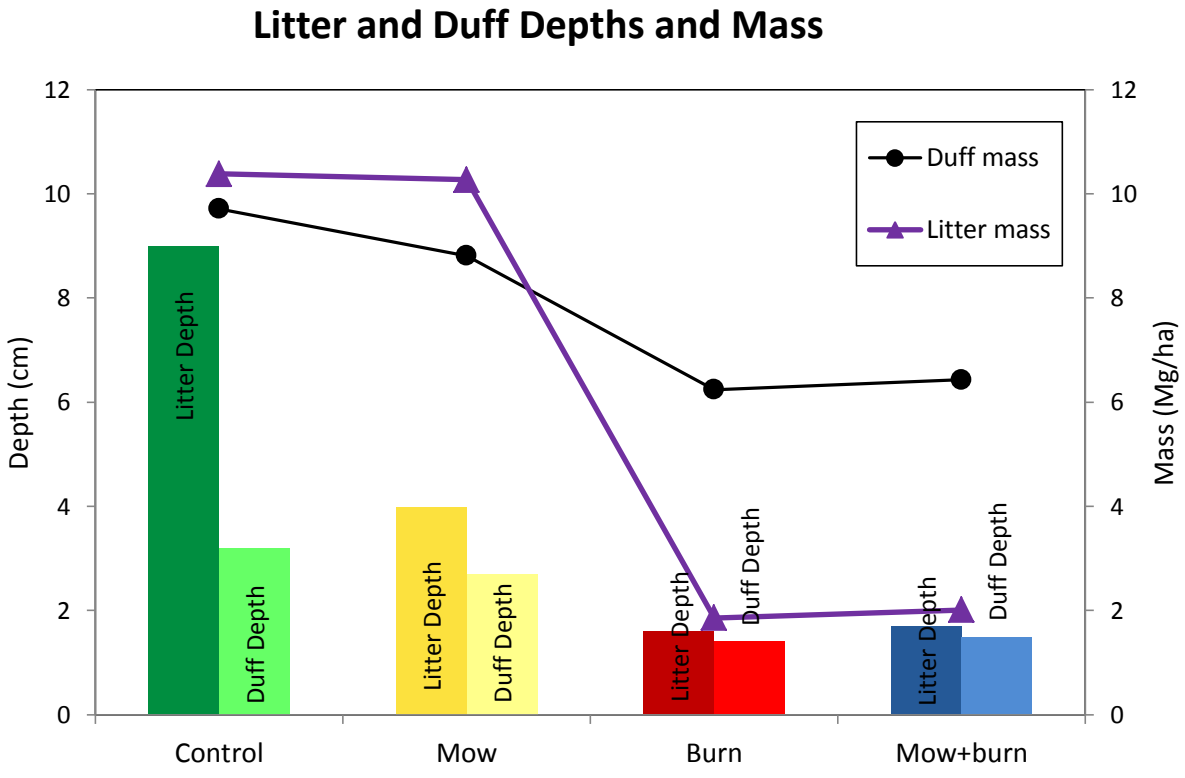


Osceola NF Fuels Treatment Effects

6 months post-burn & 1 year post-mowing

Compartment 69: As of Sept. 25, 2011

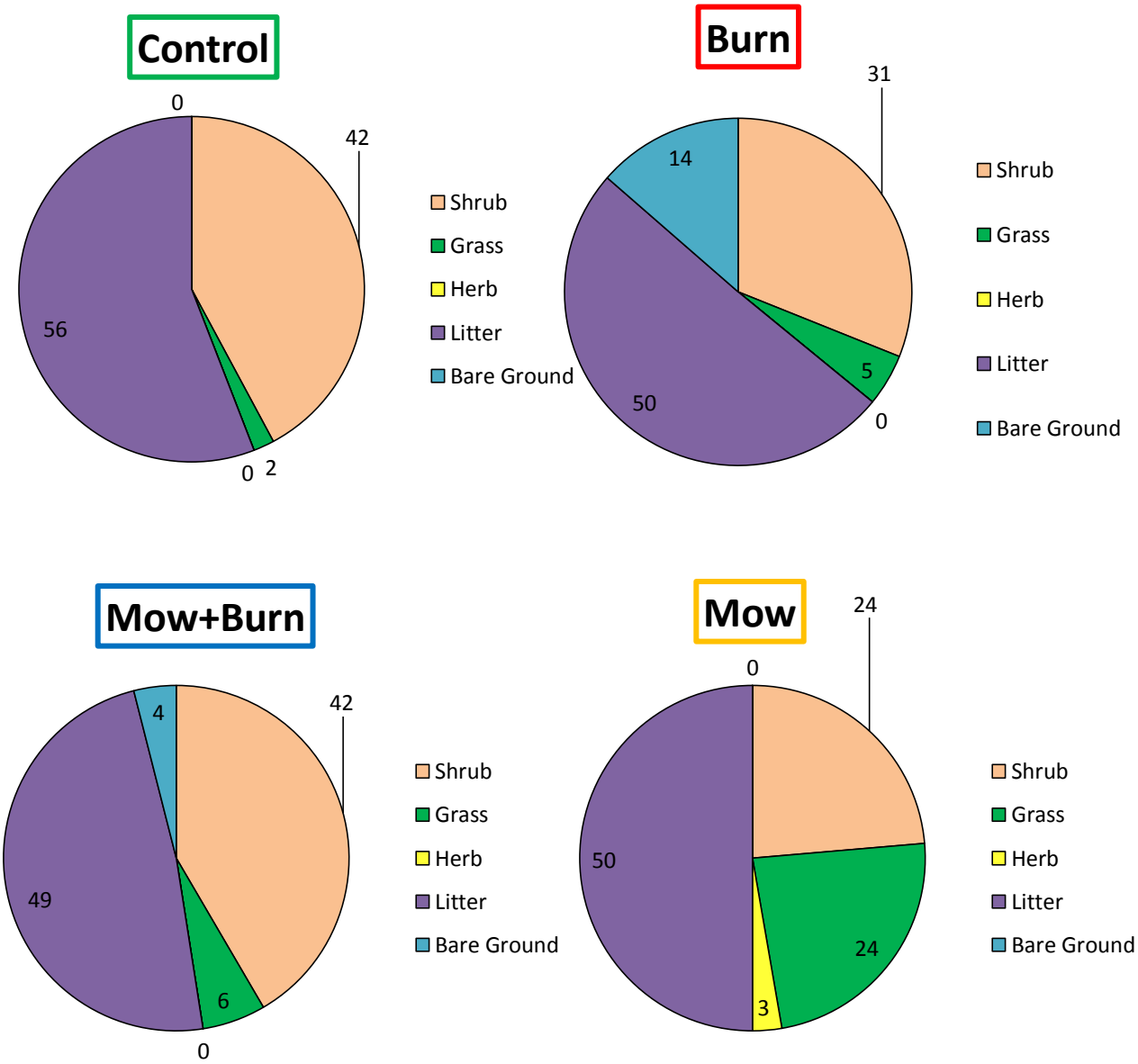




Osceola NF Fuels Treatment Effects

6 months post-burn & 1 year post-mowing

Percent Cover of Understory, Litter, and Bare Ground < 0.5 m height



Rank of Values Among Treatments

(1 = highest value, 4 = lowest value)

Biomass	**Control**	**Mow**	**Burn**	**Mow + Burn**
Shrubs	1	2	3	4
Litter	1	1	4	3
Duff	1	2	4	3
Understory				
Palmetto Cover	1	3	2	4
Palmetto Height	1	2	2	3
Other Shrub Cover	2	1	4	3
Other Shrub Height	1	2	4	3
Percent Cover				
Shrub (<0.5 m ht.)	1	4	3	2
Grass	4	1	3	2
Herb	0	1	0	0

Ranking
1=highest value
4=lowest value

0=actual value
is zero

**Underline indicates a relatively larger difference from other values*

Osceola NF Fuels Treatment Effects

Photo Guide- CONTROL

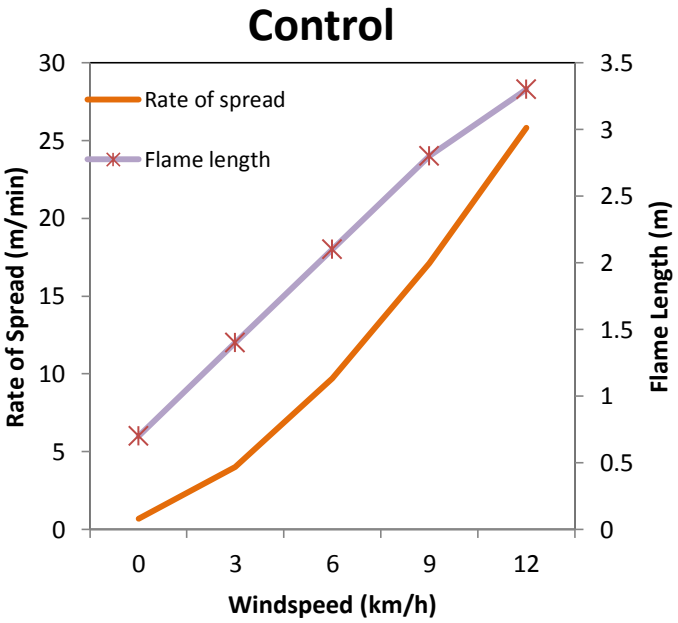
Treatment: Control

Photo Date: May 2011

Location: Osceola National Forest
Columbia County, Florida
30.2657, -82.4919

Fuel Loading

Treatment	Control	
N	7	
	mean	sd
1h *(Mg·ha^{-1})*	0.39	0.51
10h *(Mg·ha^{-1})*	1.60	1.24
100h *(Mg·ha^{-1})*	0	0
1000h S *(Mg·ha^{-1})*	0.25	0.65
1000h R *(Mg·ha^{-1})*	0	0
Litter *(Mg·ha^{-1})*	9.49	2.42
Duff *(Mg·ha^{-1})*	14.60	3.39
Shrub H-A *(Mg·ha^{-1})*	9.6	
Litter Depth *(cm)*	8.2	2.1
Duff Depth *(cm)*	5.7	1.8
Palmetto Cover *(%)*	62	24
Palmetto Height *(m)*	1.0	0.2
BA *(m^2·ha^{-1})*	19.4	6.0



Osceola NF Fuels Treatment Effects

Photo Guide- BURN TREATMENT

Treatment: Burn Only

Treatment Date: February 2011

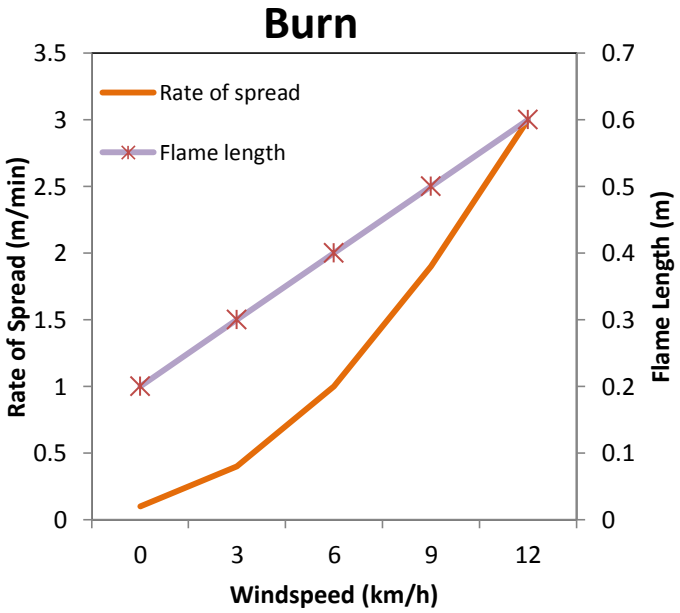
Photo Date: March 2011

Location: Osceola National Forest
Columbia County, Florida

30.2653, -82.4929

Fuel Loading

Treatment	Burn	
N	11	
	mean	sd
1h *(Mg·ha^{-1})*	0.09	0.11
10h *(Mg·ha^{-1})*	1.56	1.64
100h *(Mg·ha^{-1})*	0.27	0.60
1000h S *(Mg·ha^{-1})*	4.89	11.82
1000h R *(Mg·ha^{-1})*	0	0
Litter *(Mg·ha^{-1})*	2.22	0.62
Duff *(Mg·ha^{-1})*	11.15	2.51
Shrub H-A *(Mg·ha^{-1})*	0.30	
Litter Depth *(cm)*	1.9	0.5
Duff Depth *(cm)*	4.0	1.3
Palmetto Cover *(%)*	18	11
Palmetto Height *(m)*	0.5	0.1
BA *(m^2·ha^{-1})*	18.6	8.3



Osceola NF Fuels Treatment Effects

Photo Guide- MOW TREATMENT

Treatment: Mow Only

Treatment Date: August 2010

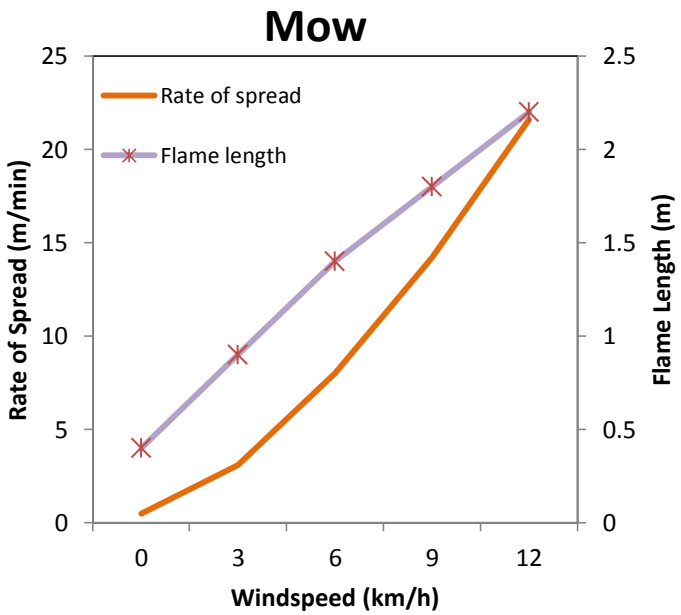
Photo Date: October 2010

Location: Osceola National Forest
Columbia County, Florida

30.2642, -82.4920

Fuel Loading

Treatment	Mow	
N	9	
	mean	sd
1h *(Mg·ha^{-1})*	0.97	0.45
10h *(Mg·ha^{-1})*	2.29	1.97
100h *(Mg·ha^{-1})*	1.16	1.63
1000h S *(Mg·ha^{-1})*	0.43	0.84
1000h R *(Mg·ha^{-1})*	0	0
Litter *(Mg·ha^{-1})*	12.88	2.40
Duff *(Mg·ha^{-1})*	12.06	2.08
Shrub H-A *(Mg·ha^{-1})*	1.2	
Litter Depth *(cm)*	5.3	1.2
Duff Depth *(cm)*	4.4	1.1
Palmetto Cover *(%)*	11	8
Palmetto Height *(m)*	0.7	0.3
BA *(m^2·ha^{-1})*	20.0	7.3



Osceola NF Fuels Treatment Effects

Photo Guide- MOW + BURN TREATMENT

Treatment: Mow & Burn

Date: Mow: August 2010

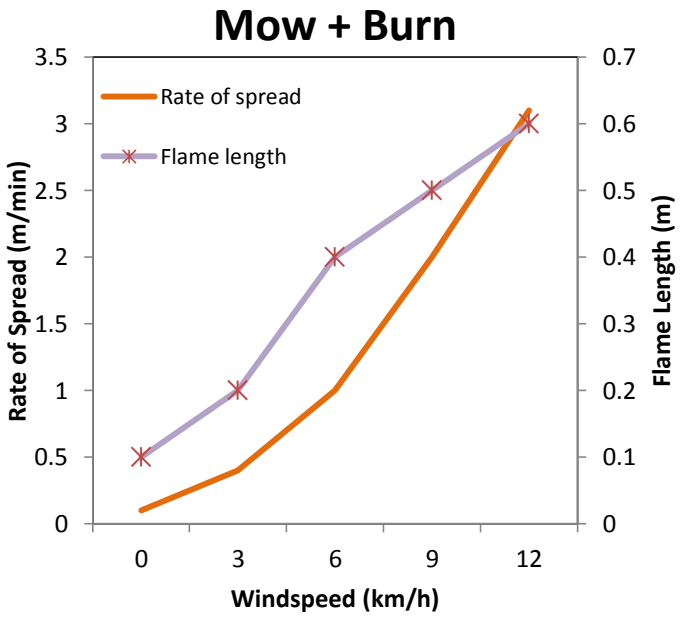
Burn: February 2011

Photo Date: March 2011

Location: Osceola National Forest
Columbia County, Florida
30.2660, -82.4909

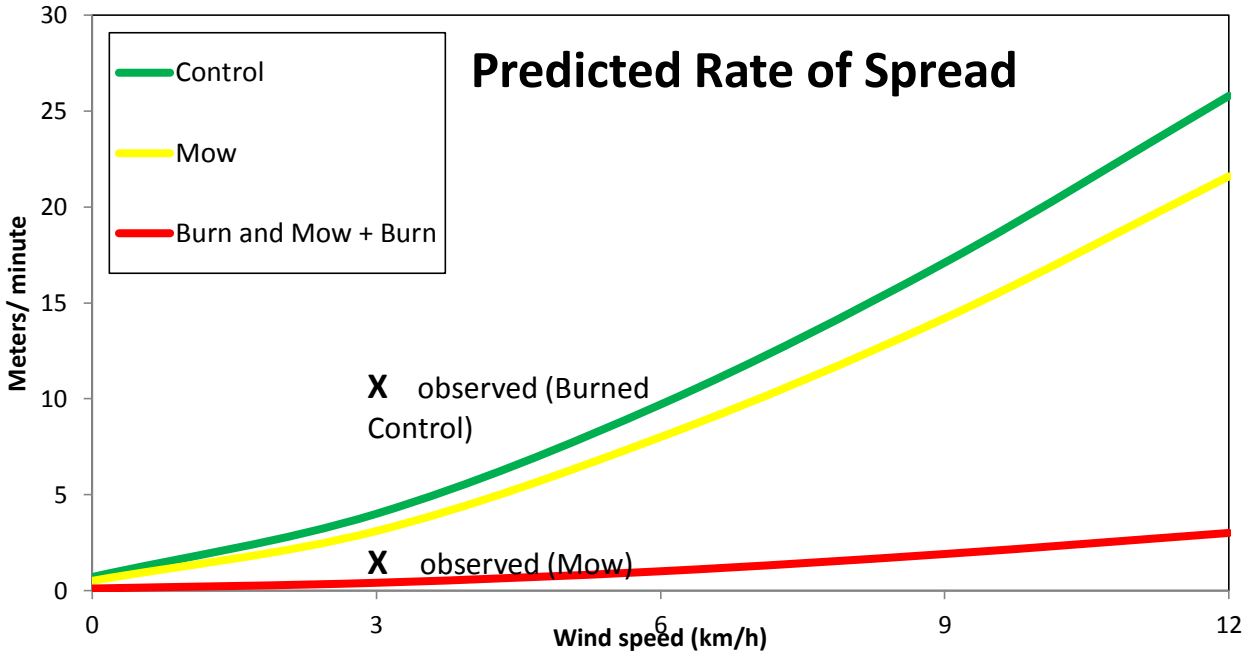
Fuel Loading

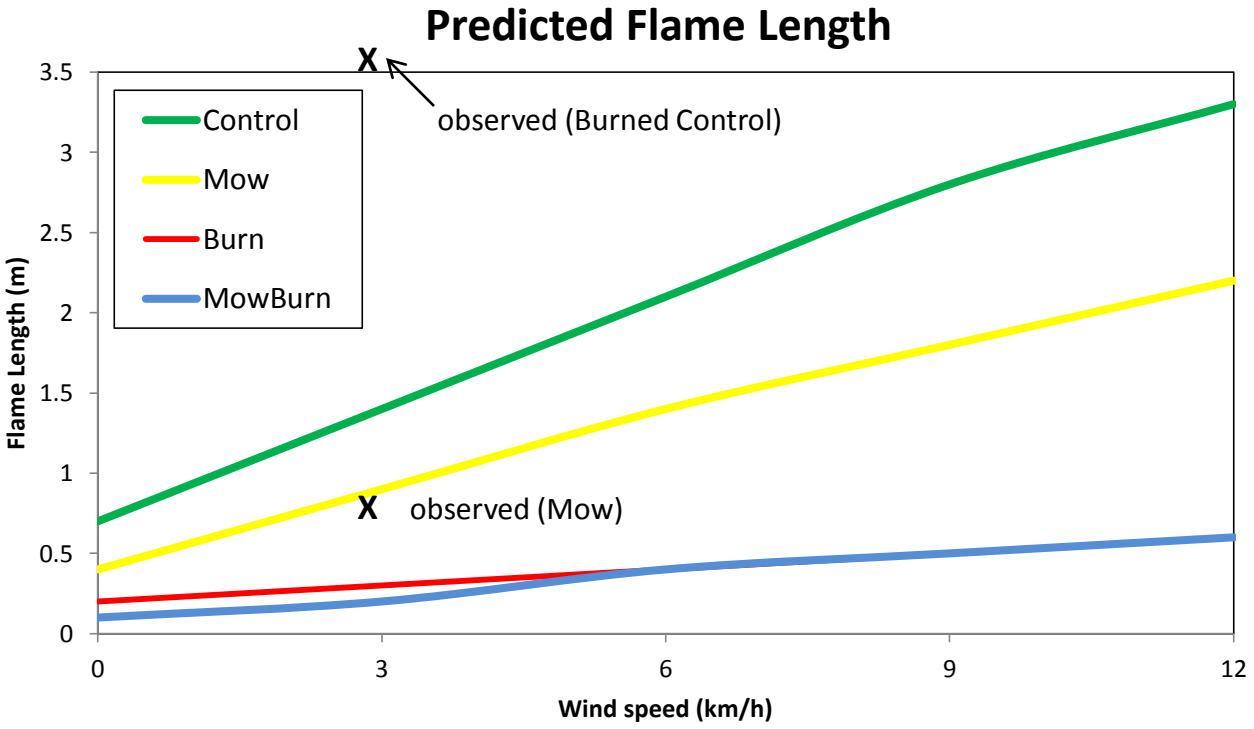
Treatment	Mow+burn	
N	9	
	mean	sd
1h *(Mg·ha^{-1})*	0.21	0.11
10h *(Mg·ha^{-1})*	1.35	0.66
100h *(Mg·ha^{-1})*	0.17	0.50
1000h S *(Mg·ha^{-1})*	0.80	1.60
1000h R *(Mg·ha^{-1})*	0.06	0.18
Litter *(Mg·ha^{-1})*	1.74	0.58
Duff *(Mg·ha^{-1})*	10.67	3.29
Shrub H-A *(Mg·ha^{-1})*	0.0	
Litter Depth *(cm)*	1.5	0.5
Duff Depth *(cm)*	3.7	1.7
Palmetto Cover *(%)*	4	3
Palmetto Height *(m)*	0.3	0.2
BA *(m^2·ha^{-1})*	22.5	10.3



Potential Fire Behavior – Immediate Post Treatment

(Behave: customized FM9 for post-burned, Hough-Albini for others; actual Rx fire conditions)



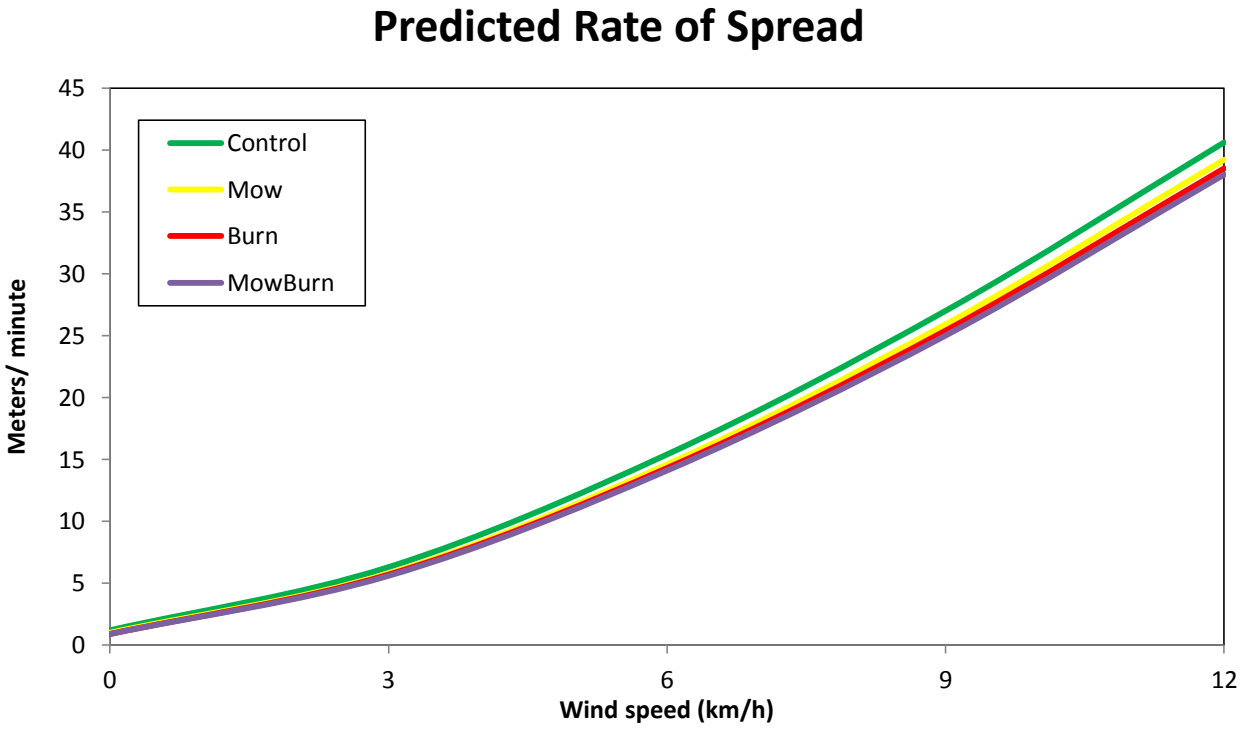


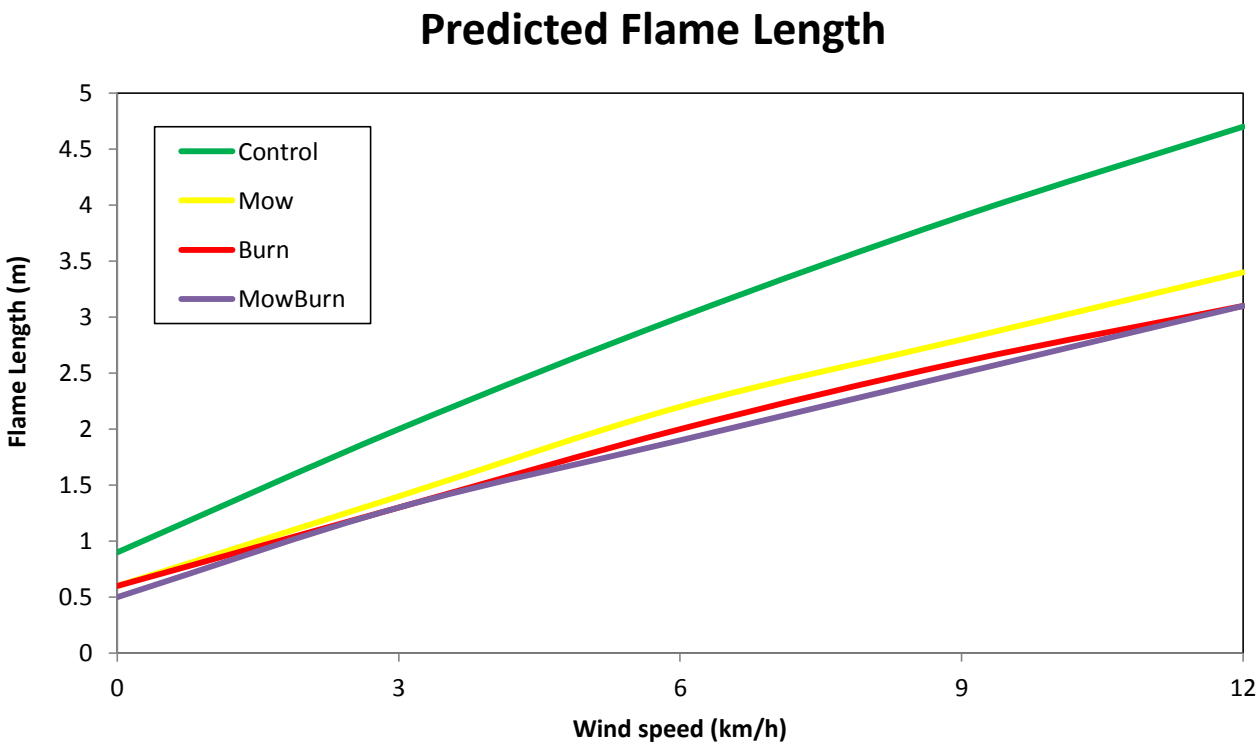
Fuels Treatment Effects on Fire Behavior

*6 months post-burn & 12 mo. post-mowing

Potential Fire Behavior – Present Day

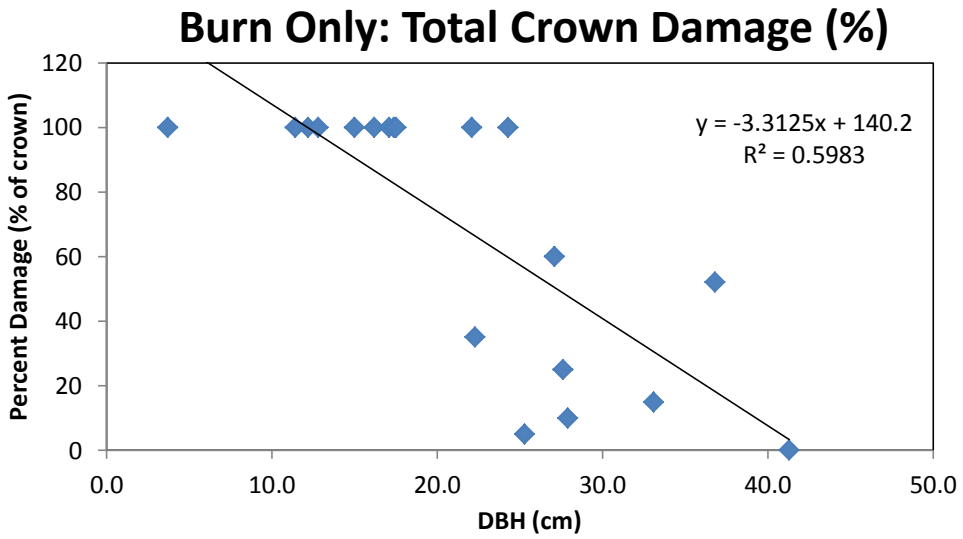
(Behave H-A model; 90th % wildfire conditions)

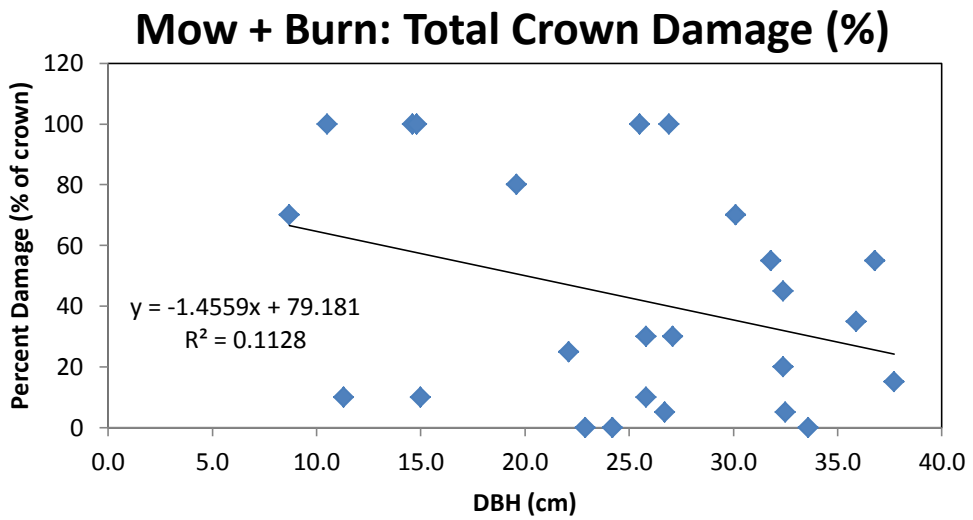


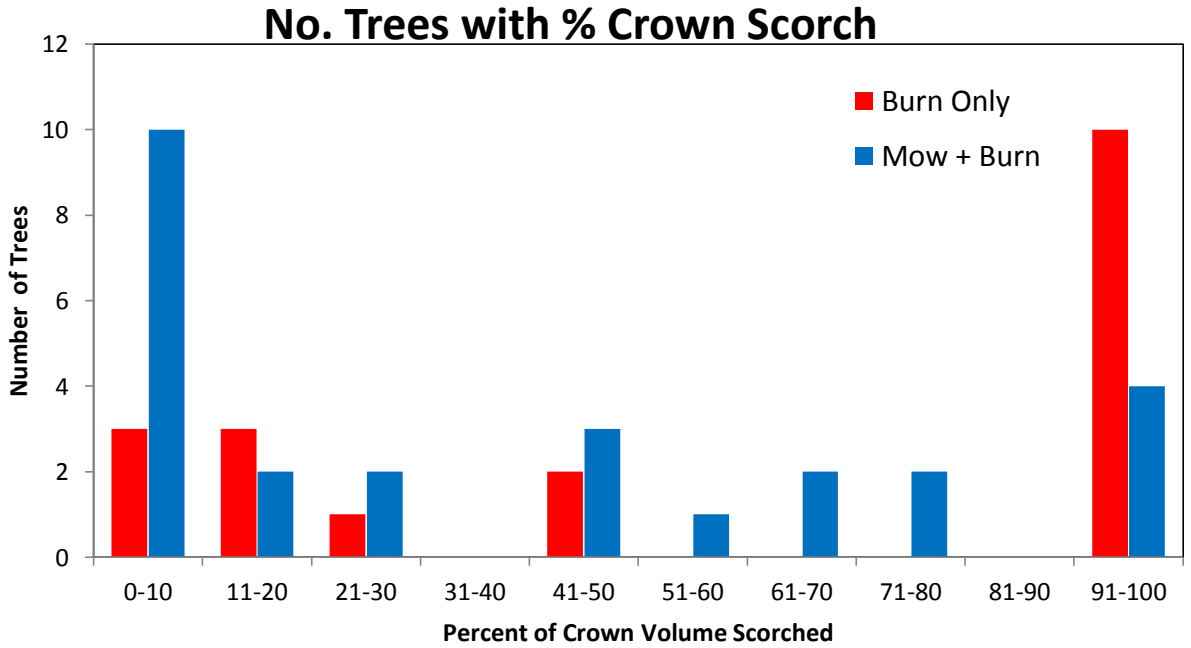


Actual Fire Effects on Trees

Burn Only and Mow + Burn (burned Feb. 26, 2011) p. 11





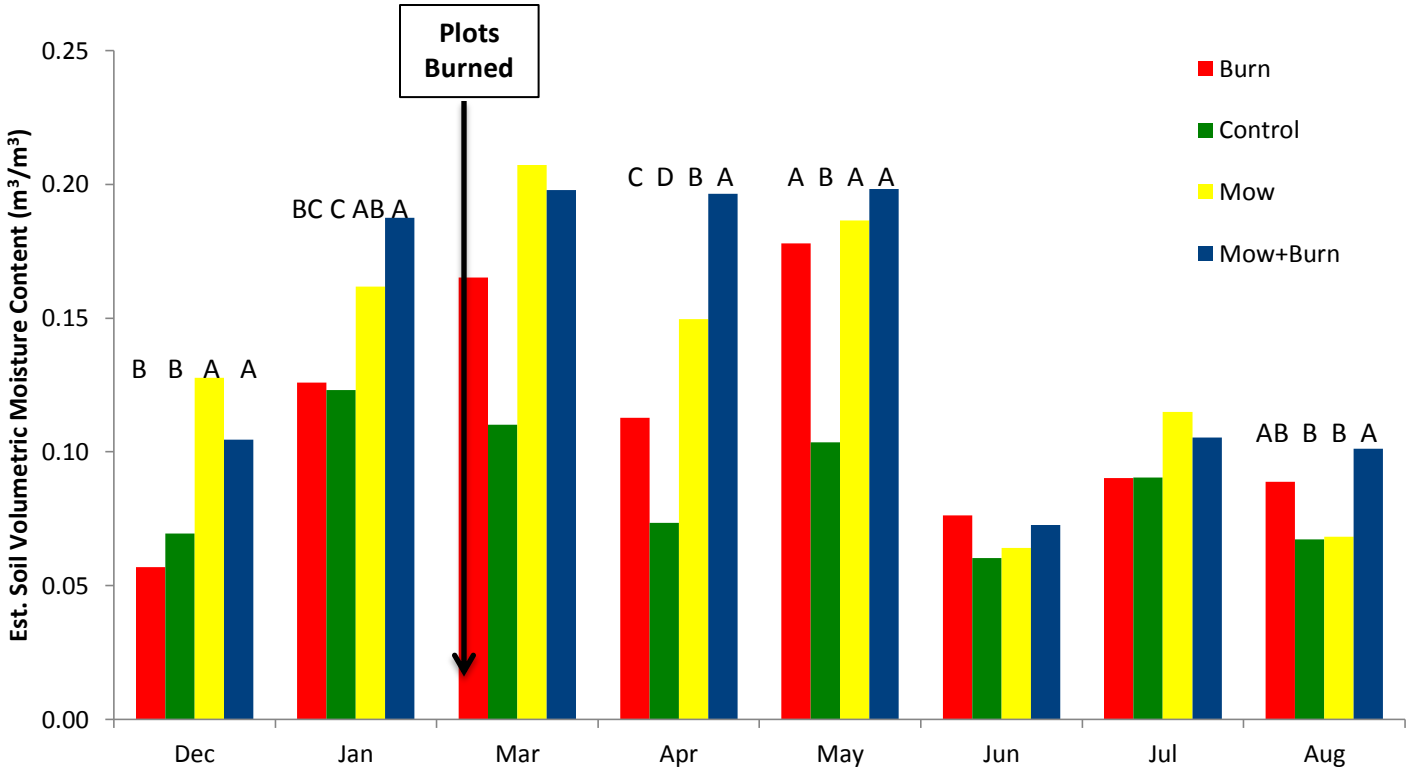


Fuels Treatment Effects on Soil T & MC%

Soil Temperature

- Burning increased soil T throughout the study period.
- Mowing reduced soil T in the winter months and increased soil T during the growing season.

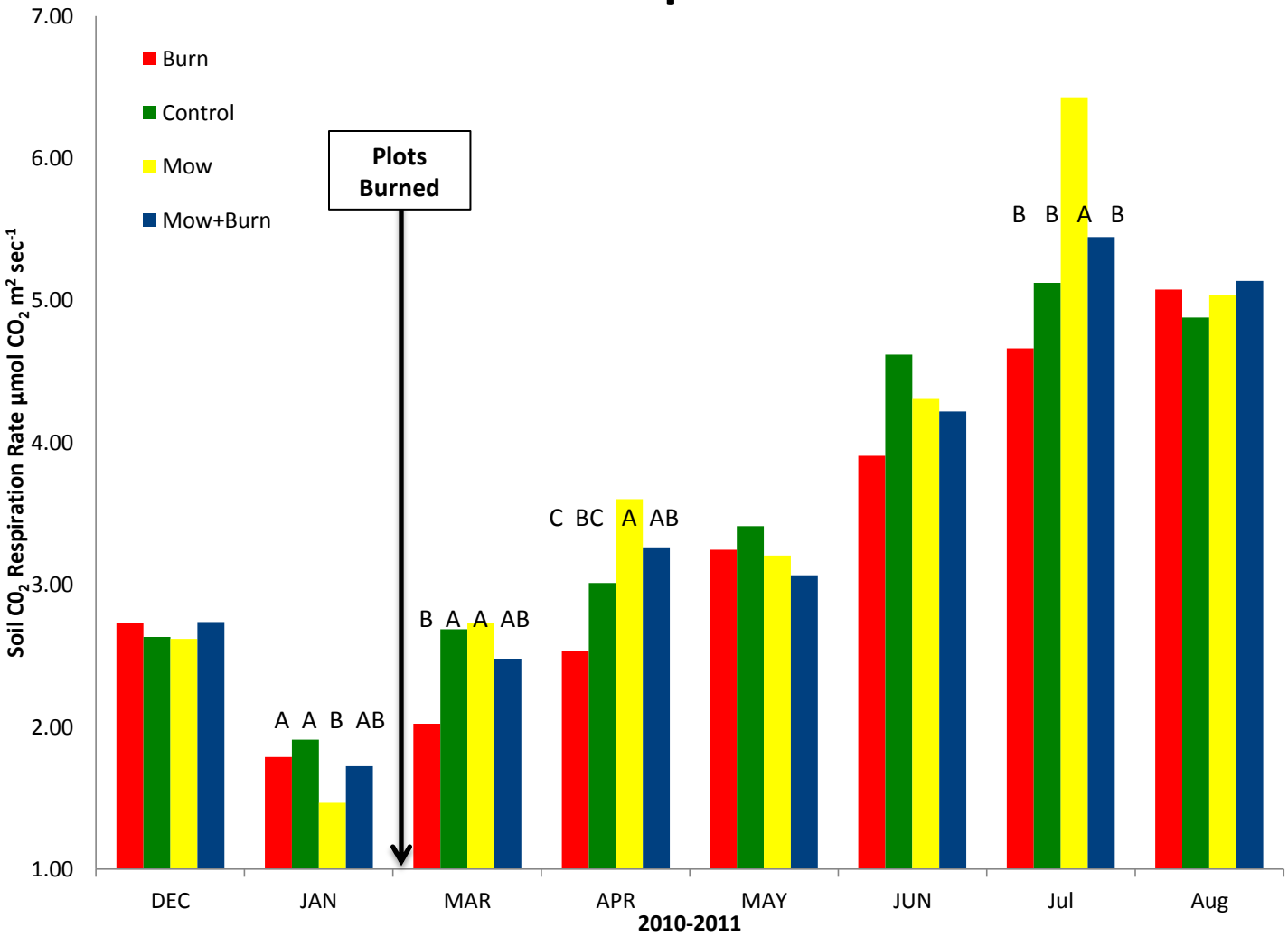
Soil Moisture



- Soil MC% was increased in the mowed plots, but less so in the droughty summer season. Increases are likely due to decreased evapotranspiration (ET) and interception, & increased litter cover.
- Burning initially increased soil MC% in the Burn Only units.
- Burning in the mowed plots did not have a clear treatment effect relative to the Mow units.

Fuels Treatment Effects on Soil Carbon

Soil Carbon Respiration Rates



Soil Carbon

- Soil carbon and soil organic matter did not differ among treatments
- Soil carbon respiration (SCR) increased from January through July with a decline in August. This trend follows seasonal variations in soil T rather than soil moisture content.
- Burning in unmowed plots reduced SCR for 2 months.
- Mowing followed by burning also showed a trend of reducing SCR.
- Mowing did not show an obvious effect on SCR.

Synopses & Take Home Messages

After 6 mo. Post Burn and 12 mo. Post Mow:

- Predictions of fire behavior suggest little difference among treatments for rate of spread
- Predictions suggest greater flame lengths in Control, and slightly greater FL in Mow units.
- Burn and Mow + Burn have virtually indistinguishable fire behavior, suggesting it is similarly mitigated by both treatment scenarios.

Observed Fire Behavior & Effects on Trees:

- After 6 mo. regrowth, Mow units had lower flame lengths and rates of spread than Burn Only
- Behave underpredicted actual fire behavior in Burn Only units.
- Mowing prior to burning effectively reduced percent crown volume scorch and TCD.
- Bark beetles and tree mortality are present in the Burn Only, but not the Mow + Burn units.

Vegetation and Ground Cover:

- 6 and 12 mo. post treatments, litter cover was near 50% in all treatments
- Burned units had more bare ground and grass than control units
- Mow Only units had the highest grass and herbaceous component
- Palmetto and other shrub height, cover, and biomass were reduced by all treatments.

Take-Home Messages

1. Although burning, (either following mowing or alone), mitigates potential fire behavior immediately post treatment**,** at six months post-burn fuels and vegetation recovered so that potential rate of spread would was no longer affected by treatment. However, flame lengths appear to be greatly reduced by all treatments when compared with controls, *even after* this recovery time period.

2. Mowing increases percent cover of herbaceous and grassy species, increasing functional diversity and potentially improving wildlife habitat. Mechanical disturbance to soils may be responsible for these effects.

3. Burning during the dormant season after Mowing decreases herbaceous and grass components of the understory, when compared with Mow alone.

4. Mowing long-unburned sites prior to reintroduction of fire reduces fire behavior, decreases crown scorch and tree mortality, and results in low fire risk. We found no evidence of increased bole or fine root damage in Mow + Burn sites.

5. Soil carbon and soil organic matter are not affected in the short-term by treatments; however, burning appears to decrease soil carbon loss and increase soil temperatures.

•***Caveat:*** *Although we have 113 plots across the forest, the data presented herein were generated from the demonstration site in compartment 69 for the purpose of this workshop. Our data collection is continuing, and our ultimate analyses will include data from all of the sampled areas, reflecting trends across the greater landscape. Conclusions may, therefore, change as the additional data are tested.*