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

Osceola National Forest Sept. 28th, 2011

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Map of Treatment Locations



0 0.05 0.1 Kilometers



Osceola NF Fuels Treatment Effects

6 months post-burn & 1 year post-mowing Compartment 69: As of Sept. 25, 2011

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Percent Cover and Average Height of Shrubs

Litter and Duff Depths and Mass



6 months post-burn & 1 year post-mowing

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



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Rank of Values Among Treatments

(1 = highest value, 4 = lowest value)

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

<u>Ranking</u>

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

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| 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 $(m^2 \cdot ha^{-1})$ | 19.4 | 6.0 |



Osceola NF Fuels Treatment Effects

Photo Guide- BURN TREATMENT

p. 6

Treatment: Burn Only Treatment Date: February 2011 Photo Date: March 2011



Location: Osceola National Forest Columbia County, Florida 30.2653, -82.4929

| 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) | 0.3 | 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

p. 7

Treatment: Mow Only Treatment Date: August 2010 Photo Date: October 2010



Location: Osceola National Forest Columbia County, Florida 30.2642, -82.4920

| 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

| 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 (m²·ha⁻¹) | 22.5 | 10.3 |



Fuels Treatment Effects on Fire Behavior p. 9

*Immediate Post-Treatment Conditions

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 p. 10

Potential Fire Behavior – Present Day (Behave H-A model; 90th % wildfire conditions)

45 Control 40 Mow 35 Burn 30 MowBurn Meters/ minute 25 20 15 10 5 0 0 3 6 9 12 Wind speed (km/h) **Predicted Flame Length** 5 4.5 Control Mow 4 Burn 3.5 Flame Length (m) MowBurn 3 2.5 2 1.5 1 0.5 0 3 6 9 12 0 Wind speed (km/h)

Predicted Rate of Spread

Actual Fire Effects on Trees

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



Percent of Crown Volume Scorched

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

p. 13

Soil Carbon Respiration Rates 7.00 Burn Control 6.00 Plots Mow Burned B B A B Mow+Burn 5.00 4.00 C BC A AB 3.00 B A A AB A A B AB 2.00 1.00 DEC JAN MAY JUN Jul MAR APR Aug

Soil Carbon

Soil CO₂ Respiration Rate μ mol CO₂ m² sec⁻¹

Soil carbon and soil organic matter did not differ among treatments

2010-2011

- 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

p. 14

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.