Fire Danger Rating of Organic Soils on the North Carolina Coastal Plain & Enhancement of NFDRS

James Reardon, RMRS Fire Science Laboratory, Missoula, MT
Gary Curcio, IPA Fire Environment Consultants, Kinston, NC
Primary Objectives

• Our ability to evaluate the potential for ground fire in organic soils is limited. Currently many of the guidelines used in fire planning and suppression are based largely on local experience.

• The Estimated Smoldering Potential or Probability (ESP) was determined through laboratory testing of the moisture limits of smoldering combustion in these soils. Prescribed burns were conducted under a range of conditions to field test the laboratory results.

• We would like to share details on the development and the use of ESP in fire danger rating on organic soils.
Emission production of ground fuels were quantified to be as much as 18 times greater than those produced from surface fuels on the Pains Bay Fire.
Safety and Health Concerns are becoming more of a driving force in wildfire suppression.

Pains Bay Fire: Dense Smoke on Highway 264 NC
Credit: Rob Shackelford, NCFS

Pains Bay Fire: Smoke Drift Map
6-24-2011
Safety and Health Concerns are becoming more of a driving force in wildfire suppression

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Pains Bay Fire: Dense Smoke on Highway 264 NC
Credit: Rob Shackelford, NCFS

Pains Bay Fire: Smoke Drift Map 6-24-2011
Suppression Activities are costly and labor intensive

Potato patching

Fire Break and Sprinkler line
North Carolina Wetlands and Study Sites

Figure 4. Wetlands

Pocosin
Swamp on a hill

Pond Pine Woodlands  High Pocosin  Low Pocosin  High Pocosin  Pond Pine Woodlands

Decreasing Organic Soil Thickness Decreasing

Decreasing Hydroperiod Decreasing

Increasing Fire Frequency Increasing
Soil Horizons

Root mat

Muck/Sapric
Laboratory Testing
No Burn/ Burn Threshold
Estimated Smoldering Probability
Moisture Limits of Root Mat Soils

North Carolina Root Mat

<table>
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<tr>
<th>Soil Type</th>
<th>Moisture Content</th>
<th>Mineral Content</th>
<th>Estimated Smoldering Potential</th>
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<tr>
<td>North Carolina Root Mat</td>
<td>181</td>
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<td>6.3%</td>
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Moisture Limits of Lower Muck Soils

North Carolina Sapric

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<th>Soil Type</th>
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<th>Alaska Feather moss</th>
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</table>

Moisture Content: 261
Mineral Content: 0 0 0
Estimated Smoldering Potential: 9.4% 9.4% 9.4%
After several weeks of burning, 2 ft. ground elevation loss & 384 T/Ac

Research Prescribed Burn
Green Swamp, Brunswick County NC

![Image of fire in a forest]

![Graph showing depth and moisture content]

- Root Mat ESP <10%
- Muck Soil ESP <10%

- Pre burn surface
- Post burn surface
- Water table

![Graph showing relative elevation (ft) vs. distance (ft) along transect]
Heating of ground fuels minutes vs. hours

Prescribed fire burning conditions

Wildfire burning conditions
Driving Creek Burn
Driving Creek Burn

### Weather Information Management System

| Station ID | Obs Dt  | Tm | O T | MSGC | WS | WDY | HRB | 1H | 10 | HU | TH | XH | IC | SC | EC | BI | SL | R | KBIDI |
|------------|---------|----|-----|------|----|-----|-----|----|----|----|----|----|----|----|----|---|----|----|   |
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| 319803     | 021109  | 14 | O   | 701P3 | 14 | 70  | 11  | 11 | 12 | 17 | 22 | 22 | 8  | 22 | 30 | 60 | 3  | M  | 64  |
| 319803     | 021109  | 14 | O   | 701P3 | 14 | 70  | 11  | 11 | 12 | 17 | 22 | 22 | 12 | 14 | 19 | 39 | 2  | L  | 64  |
Root mat moisture content

Well above critical thresholds of:
- UR ≥ 170%
- LR ≥ 270%

Very Little Consumption of mat & smoldering
Head fire of Edna Buck Fire reaches DAQ monitors.

Edna Buck Fire burns organics with canal water present.

Generally when the “Root Mat” moisture content reaches “170% or less”, the probability of sustained ignition dramatically increases & residual smoke becomes a serious issue.
## Camp Lejeune Pocosin Burn

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Soil moisture and estimated smoldering potential at Pocosin Lakes NWR

Trends identify windows of opportunity & avoidance or readiness

Fire Tower ESP Sta. – wet side of the refuge
Remote Measurements
Soil Moisture Active Passive Satellite offers the possibility of assessing ground soil moisture remotely.
The next project phase is to determine can we correlate remote ground data with remote satellite data.

Will the satellite relay the necessary information relative to what ESP requires at an acceptable resolution?

Cell telemetry
2 tipping buckets
Fuel temp
10hr fuel moist
Soil Temp
Root Mat ESP
Muck ESP
ET Gauge
Well
Solar Panel
There are 4 geographic fire danger areas for ground fuels which will require different algorithms.
With improved soil moisture information coming from SMAP & fire danger remotely sensed, will the user community apply the information to assist in prescribed fire and wildfire management decisions?
Summary

- ESP has been a reliable predictor on the lack of organic soil consumption for research burns which was consistent with laboratory work and other burns conducted on similar sites.

Acknowledgements

- We would like to thank the Nature Conservancy, USFWS, DOD at Camp Lejeune, and NCFS for their collaboration on the ESP project.