<u>Surface Fuels</u>

<u>Lab objectives</u>:

1) Become familiar with techniques (e.g., adapted Brown 1974, Gen. Tech. Report INT-16) used to estimate surface fuel loads important to understanding fire behavior;
2) Identify appropriate fuel models (standard 13; Anderson 1982; Gen. Tech. Report INT-122) in the field based on the anticipated fuels that would be consumed during a surface fire;
3) Use BehavePlus to simulate fire behavior characteristics for multiple fuel models given provided fuel moisture content and wind speed values.

<u>Assignment:</u> Submit: 1) written methods (past-tense, proofread, error free, your words.): including general site characteristics, fuel model, average percent ground cover by litter, grass, and shrub fuels;
2) results table (properly formatted) summarizing the average fuel loads (tons/ac) by: 1-, 10-, 100-, and 1,000-hr classes; litter depth; and the overall (all size classes) stand average for downed woody material fuel load (tons/ac);
3) raw data sheets showing plot-level calculations;
4) BehavePlus outputs showing Surface Rate of Spread (ch/hr), Fireline Intensity (Btu/ft/s), and Flame length (ft) for simulations using data provided below.

<u>In Field: Fuel plots (downed woody material)</u>

<u>At 4 sampling point locations (one chain apart, instructor will direct you to first point)</u>:

1) Fuel transects
   a. Layout two-25 ft transects across plot center (azimuths of 30° & 120°)
   b. For each transect (keep data separately for each transect), use the Go-No-Go gauge to tally the number of intersections with:
      i. 1-hr (≤ 1/4"diameter) & 10-hr (> 1/4 to ≤ 1") fuels along the southernmost 6 feet of each transect
      ii. 100-hr (> 1 to ≤ 3") fuels along the southernmost 10 feet of each transect
      iii. 1,000-hr (> 3") fuels along all 25 feet of both transects
         1. For each 1,000-hr fuel- measure/estimate diameter at point of intersection & determine whether it is sound or rotten
   c. Measure litter depth using the ruler in an undisturbed area near each tape end
   d. Visually estimate litter, grass, and shrub percent ground cover as potential fuels
   e. Record slope (%) for the plot location (use % side on clinometer)

<u>BehavePlus simulations</u>: (** Note: this is separate and not necessarily related to your field fuel load measurements! **)

<u>Scenario 1: Fuel Model 2</u> (Timber grass & understory)
<u>Scenario 2: Fuel Model 9</u> (Long needle or hardwood litter)
Fuel moistures: 1-hr (7%), 10-hr (9%), 100-hr (13%) live herbaceous (45%)
Midflame wind speed: 10 mph; Slope: 1%

Plot 1: 30° Transect
Plot slope: ______%

1 & 10-hr fuel tallies (along the southernmost 6 feet of transect)**

1-hr (≤ 1/4")	10-hr (>1/4" to ≤ 1")

100-hr fuel tally (along the southernmost 10 feet of transect)**

100-hr (> 1" to ≤ 3")

1,000-hr fuel tally & diameters (along entire 25 foot transect)**

Diameters (inches)	
Sound (not heavily decomposed)	Rotten (not solid-pencil test)

Litter depths (each end of tape): _________________, _________________

% ground cover (general Plot 1 area): litter = _______, grass = ______, shrubs = ______

Additional comments:

Plot 1: 120° Transect

Plot slope: ______%

1 & 10-hr fuel tallies (along the southernmost 6 feet of transect)**

1-hr (≤ 1/4")	10-hr (>1/4" to ≤ 1")

100-hr fuel tally (along the southernmost 10 feet of transect)**

100-hr (> 1" to ≤ 3")

1,000-hr fuel tally & diameters (along entire 25 foot transect)**

Diameters (inches)	
Sound (not heavily decomposed)	**Rotten (not solid-pencil test)**

Litter depths: _________________, _________________

Additional comments:

Plot 2: 30° Transect
Plot slope: ______%

1 & 10-hr fuel tallies (along the southernmost 6 feet of transect)**

1-hr (≤ 1/4")	10-hr (>1/4" to ≤ 1")

100-hr fuel tally (along the southernmost 10 feet of transect)**

100-hr (> 1" to ≤ 3")

1,000-hr fuel tally & diameters (along entire 25 foot transect)**

Diameters (inches)	
Sound (not heavily decomposed)	**Rotten (not solid-pencil test)**

Litter depths: ________________, ________________

% ground cover (general Plot 2 area): litter = _______, grass = ______, shrubs = ______

Additional comments:

Plot 2: 120° Transect
Plot slope: ______%

1 & 10-hr fuel tallies (along the southernmost 6 feet of transect)**

1-hr (≤ 1/4")	10-hr (>1/4" to ≤ 1")

100-hr fuel tally (along the southernmost 10 feet of transect)**

100-hr (> 1" to ≤ 3")

1,000-hr fuel tally & diameters (along entire 25 foot transect)**

Diameters (inches)	
Sound (not heavily decomposed)	**Rotten (not solid-pencil test)**

Litter depths: _________________, _________________

Additional comments:

<u>Plot 3: 30° Transect</u>
Plot slope: ______%

<u>1 & 10-hr fuel tallies</u> (along the southernmost <u>6 feet</u> of transect)**

1-hr (≤ 1/4")	10-hr (>1/4" to ≤ 1")

<u>100-hr fuel tally</u> (along the southernmost <u>10 feet</u> of transect)**

100-hr (> 1" to ≤ 3")

<u>1,000-hr fuel tally & diameters</u> (along <u>entire 25 foot</u> transect)**

Diameters (inches)	
Sound (not heavily decomposed)	Rotten (not solid-pencil test)

<u>Litter depths</u>: _________________, _________________

% ground cover (general Plot 3 area): litter = _______, grass = ______, shrubs = ______

Additional comments:

Plot 3: 120° Transect
Plot slope: ______%

1 & 10-hr fuel tallies (along the southernmost 6 feet of transect)**

1-hr (≤ 1/4")	10-hr (>1/4" to ≤ 1")

100-hr fuel tally (along the southernmost 10 feet of transect)**

100-hr (> 1" to ≤ 3")

1,000-hr fuel tally & diameters (along entire 25 foot transect)**

Diameters (inches)	
Sound (not heavily decomposed)	Rotten (not solid-pencil test)

Litter depths: ________________, ________________

Additional comments:

Plot 4: 30° Transect
Plot slope: ______%

1 & 10-hr fuel tallies (along the southernmost 6 feet of transect)**

1-hr (≤ 1/4")	10-hr (>1/4" to ≤ 1")

100-hr fuel tally (along the southernmost 10 feet of transect)**

100-hr (> 1" to ≤ 3")

1,000-hr fuel tally & diameters (along entire 25 foot transect)**

Diameters (inches)	
Sound (not heavily decomposed)	**Rotten (not solid-pencil test)**

Litter depths: _________________, _________________

% ground cover (general Plot 4 area): litter = _______, grass = ______, shrubs = ______

Additional comments:

Plot 4: 120° Transect
Plot slope: ______%

1 & 10-hr fuel tallies (along the southernmost 6 feet of transect)**

1-hr (≤ 1/4")	10-hr (>1/4" to ≤ 1")

100-hr fuel tally (along the southernmost 10 feet of transect)**

100-hr (> 1" to ≤ 3")

1,000-hr fuel tally & diameters (along entire 25 foot transect)**

Diameters (inches)	
Sound (not heavily decomposed)	Rotten (not solid-pencil test)

Litter depths: ________________, ________________

Additional comments:

After field plots: Calculate fuel loads

Equations to calculate:

1, 10, 100-hr fuels (tons/acre) = $\frac{\mathbf{k} \times \mathbf{n} \times \mathbf{d^2} \times \mathbf{s} \times \mathbf{a} \times \mathbf{c}}{\mathbf{N} \times \mathbf{L}}$

where, **k =** a constant

n = # of fuels (occurrences) that crossed the transect

$\mathbf{d^2}$ = midpoint of diameter range squared (for instance, for 1-hr: 0 to ¼" would be 0.125^2)

s = specific gravity (differs by size & species)

a = horizontal slope of fuel

c = slope correction factor

N = # of transects per plot

L = transect length (feet)

1,000-hr fuels (tons/acre) = $\frac{\mathbf{k} \times \mathbf{\Sigma d^2} \times \mathbf{s} \times \mathbf{a} \times \mathbf{c}}{\mathbf{N} \times \mathbf{L}}$

where, **k =** a constant

$\mathbf{\Sigma d^2}$ = sum of all squared diameters

s = specific gravity of species (differs by size, species, & whether fuel is solid)

a = horizontal slope of fuel

c = slope correction factor

N = # of transects per plot

L = transect length (feet)

For each plot: use these provided equations to calculate 1, 10, 100, & 1,000-hr fuels

1-hr (tons/acre) = $\dfrac{(11.64) \times (n) \times (0.156) \times (0.48) \times (1.0) \times (1.0)}{(2) \times (6)}$

10-hr (tons/acre) = $\dfrac{(11.64) \times (n) \times (0.289) \times (0.48) \times (1.0) \times (1.0)}{(2) \times (6)}$

100-hr (tons/acre) = $\dfrac{(11.64) \times (n) \times (2.76) \times (0.40) \times (1.0) \times (1.0)}{(2) \times (10)}$

Solid: 1,000-hr (tons/acre) = $\dfrac{(11.64) \times (\text{sum of squared diameters}) \times (0.40) \times (1.0) \times (1.0)}{(2) \times (25)}$

Rotten: 1,000-hr (tons/acre) = $\dfrac{(11.64) \times (\text{sum of squared diameters}) \times (3.0) \times (1.0) \times (1.0)}{(2) \times (25)}$

Calculated fuel loads (turn this page in!)

Plot 1:
1-hr = ____________________________
10-hr = ___________________________
100-hr = __________________________
Solid 1,000-hr = ___________________
Rotten 1,000-hr = __________________

Plot 1 total fuel load = ______________

Show work for Plot 1 below:

Plot 2:
1-hr = ____________________________
10-hr = ___________________________
100-hr = __________________________
Solid 1,000-hr = ___________________
Rotten 1,000-hr = __________________

Plot 2 total fuel load = ______________

Show work for Plot 2 below:

Calculated fuel loads (turn this page in!)

Plot 3:
1-hr = ___________________________
10-hr = __________________________
100-hr = _________________________
Solid 1,000-hr = ___________________
Rotten 1,000-hr = __________________

Plot 3 total fuel load = ______________

Show work for Plot 3 below:

Plot 4:
1-hr = ___________________________
10-hr = __________________________
100-hr = _________________________
Solid 1,000-hr = ___________________
Rotten 1,000-hr = __________________

Plot 4 total fuel load = ______________

Show work for Plot 4 below:

Average Fuel Load for stand ___________________ (average plot values)