**Piñon and Juniper Tree Mastication Effects in the**

**Great Basin and Colorado Plateau**

Sampling Protocol: Summer 2011/2012 (*fuels and vegetation*)

**Subplot Set-Up (subplots are 30 X 33 m in size, see Figure 1)**

1. Plot set-up
2. Find GPS Center Point
   1. If there is no slope, run a 33 m tape east to west with the 15 m mark at the center GPS point.
   2. If there is a slope, run a 33 m tape parallel to the slope contour.
3. Use the “double right angle prism” to run the 30 m (baseline) transects.
   1. Stand at the end(s) of your 33 m tape ran in step 1 and run a 30 m tape on each side. The 15 m mark should be the center point at the end of the 33 m tape.
   2. Anchor the subplot corners (30 m tapes) with steel pins.
   3. Place “jabbers” along the “zero 30 m tape” at 2, 7, 11, 23, and 28 m.

\* 0 to 30 m reads from left to right looking up slope or looking across the plot.

1. Lay-out the 33 m tapes along the baseline “30, 30 m tape” with two steel pins per tape.
   1. There are six transects (5 vegetation, 1 herbaceous fuels) within every subplot.
   2. The transects are at the **2, 7, 11A, 15\*, 23, 28** meter mark.

A this transect is where the herbaceous biomass will be collected *only*.

\* the 15 meter transect should have already been run in step 1.

**Subplot Set-Up Rules**

* Tape should be taut
* Tape should be as close to the ground as possible
* When walking the length of the transect always walk on the non-graduated side of the tape to avoid trampling vegetation in the sample area.
* There is a 1.5 m buffer from the subplot edge to the start and end of each transect.



**Figure 1. Subplot and transect layout**

**Subplot Information (Datasheet 1/subplot checklist)**

1. Open data sheets on field computers
2. *Please make sure you open the correct file (location, subplot, etc.).*
3. At the top of *every* data sheet there is a site-subplot code that needs to be completely filled out using the following information:
4. Region Name: **UT**
5. Site Name:
6. Plot Type: **BH** (**B**ull**H**og study)
7. Treatments: **CO**ntrol (CO), **B**ullhog-**M**echanical (BM), and **B**ullhog-Prescribed **F**ire (BF)
8. Subplot number
9. Year sampled: 2011 or 2012
10. Data collector’s initials

**Subplot Information Rules**

* **Date needs to be changed on computer M for each subplot**

**Subplot Description (Datasheet 1/subplot checklist)**

1. Record the UTM coordinates for the zero corner (lower left corner when looking up hill) of the subplot and at the center of the subplot with the Site code\_Treatment subplot number\_location **Example: SL\_BM10\_M (M for subplot center) and SL\_BM10\_0 (0 for the zero corner) (turn GPS on in waypoints push the mark button and arrow up to the name and hit enter to change it.)**
2. Measure and record the percent slope of the plot using a clinometer (usually stand a couple of transects apart).
3. Determine and record the aspect (in degrees) of the subplot using a compass (stand facing toward the 2m transect. Line the arrow up with N. Then twist the movable arrow so that it points in the direction the plot is facing)
4. Determine and record the macro-topography (see figure 2) of the subplot.
5. Determine and record the micro-topography (flat, concave or convex) of the subplot.
   1. Concave: curving in or hollow inward
   2. Convex: curving out or bulging outward

Ridgetop

Sideslope

Terrace

Bottom

**Figure 2. Subplot macro-topography**

**Photo Points**

1. Photos should be taken before any sampling begins within the subplot.
2. Place a meter pole with 10 cm gradations at the center of the middle transect (15 m).
3. Record site information **[Site, Treatment, Subplot #, Date, Transect # and photo origin point (0m or 30m)] on the chalk board.**
4. Place chalk board in view of the camera so that it can be read in the photograph. If possible this should be around 2 m from photo origin point and on the ground.
   1. **The plot sign is not the focus on the picture. The smaller, yet legible sign, the better.**
5. Take one photo from the 0 m point on the transect looking towards the 30 m point along the same transect.
6. Take the second photo from the 30 m point on the transect looking towards the 0 m point along the same transect ***(don’t forget to change the chalkboard to say 30m).***

**Photo Point Rules**

* When taking the photograph, minimize the horizon as much as possible (the photo does not need to include much sky). The horizon should be straight across the photo.
* People can NOT be visible in the picture.
* If you can’t see the middle of the transect on the 15m, take another set of pictures on the 7m transect following steps 1 thru 5.
* If you cannot see the middle of the 7m transect, take another set of pictures on the 23 m transect following steps 1 thru 5.

**Fuel Load Measurements**

**Down Woody Debris (DWD) planar intercept method (Datasheet 2) *(1000-hr only on BM)***

1. One-, Ten-, 100- and 1000-hr DWD will be sampled on the 7-, 15- and 23-m transects. The 2- and 28-m transects will be sampled for 1000-hr DWD only.
2. Only DWD that intercept the transects at heights <2 m will be sampled.
3. Sample DWD on the graduated side of the tape using a fuels gauge to determine the size class of the DWD.
4. Only the 1-, 10- and 100-hr DWD will be tallied.
5. For 1000-hr DWD, fuel diameters will be determined at the point where the fuel intercepts the transect and measured at an angle perpendicular to the axis of the fuel piece.
6. For 1000-hr DWD, the diameter of each intercept will be recorded *by species* in one of two decay classes.
   1. a. If wood is hard it is recorded in Decay class 1 “Solid”
   2. b. If wood is soft it is recorded in Decay class 2 “Rotten” (i.e. dry rot or severely weathered)

**DWD Rules**

* Only dead wood (attached and detached) is measured (including twigs, stems, and branches).
* Dead material on a live plant is not counted; a plant is considered dead if < 10% is alive.
* DWD that is more than 50% below the soil surface will not be counted.
* Bark on the ground is not counted.
* 1-hr fuels: < 0.25” in diameter (do not include grass or litter); 10-hr fuels: 0.25 to 1”; 100-hr fuels: 1to 3”

**Bullhog shredded fuels collection (Datasheet 3)**

A. Collect 1, 10, and 100-hr fuels

1. # of transects sampled based on Phase (tree density: 1-low and 3-highest)
   1. Phase I: 5 transects – 2, 7, 15, 23, 28
   2. Phase II: 3 transects – 7, 15, 23
   3. Phase III: 3 transects – 7,15, 23
2. Use 25 x 25-cm quadrat
3. Place quadrat every 3rd meter on uphill graduated side of transect
   1. Place lower left corner of quadrat at 0.1, 3.1, 6.1, 9.1, 12.1, 15.1, 18.1, 21.1, 24.1, 27.1-m to avoid line-point measurements at the meter mark.
   2. Quadrat extends up 2-m to include dead branches on live or dead shrubs and trees
4. **Take an average depth of the fuel in the quadrat**
5. Cut woody fuels under perimeter of quadrat with gear-driven pruning loppers
6. Collect material within the quadrat
   1. Include needles and bark from shredded trees
   2. Include DWD that is not part of shredded fuels including: dead branches, sticks of any species shredded or not
   3. Exclude black dead needles of the pre-treatment canopy litter mound
   4. Bag label: Location, Treatment, Subplot #, record each Transect Sampled

**Shredded Fuels Collection**

* **Double bag the bags!**

**Line-Point Intercept (Datasheet 4)**

1. Begin at the “0” end of the transect (You may start at the 30m, just make sure you record the data correctly).
2. Always stand on the non-gradient side of the line.
3. Drop a pin flag to the ground from a standard height of 5 cm above herbaceous canopy next to the tape.

**Line-Point Rules (1)**

* The pin should be held vertical before dropping.
* The pin should be dropped from the same height (~5 cm) above the vegetation each time. A low drop height minimizes “bounces” off of vegetation but increases the possibility for bias.
* Do not guide the pin all the way to the ground. It is more important for the pin to fall freely to the ground than to fall precisely on the mark.
* Even if vegetation over the point is greater than shoulder height the pin should never be dropped from higher than the height of the out-stretched arm.

1. If vegetation is above the height of the out-stretched arm, record the species of the tree or shrub canopy or foliar hit up to 2 m above the soil surface.

**Line-Point Rules (2)**

* If the pin hits a point where there is a tree canopy overhead, but you would not hit actual vegetation (i.e. the footprint of the tree) record the species code for the tree under “tree canopy” column. Record whether the branches of the tree above are dead or alive. For control plots: Y= Dead, N= Alive. For bullhogged plots: Y= Dead with NO needles attached, P= dead with needles still attached, N= alive not bullhogged.
* If there is a hole of 50 cm or greater (i.e. a very clear obvious gap in vegetation) in the canopy with no vegetation, than no canopy hit will be recorded.
* If the tree is unidentifiable record DT in species code.

1. Once the pin flag is flush with the ground, record every plant species it intercepts.
2. Record the species of the first stem, leaf or plant base intercepted in the first “Foliar Layer” column using the PLANTS database species code (<http://plants.usda.gov/>).
3. If the pin intercepts standing dead material record the standing dead by growth form (it is not necessary to record the species) as follows:

DT Dead tree

DS Dead shrub

DF Dead forb

DG Dead grass

1. If the point hits a dead branch of a live shrub, record DS for the foliar hit.
2. In the bullhog treatment use “CW” for pieces of wood or bark on the ground that do not have limbs attached and are obviously a result of felling the tree. Use “CT” for felled trees that have limbs still attached. **Additionally, CT can be used as a tree canopy code, but use either “P” if foliage is still on branches or “Y” if felled tree no longer contains foliage**.
3. Record all additional species intercepted by the pin in the subsequent “Foliar Layer” columns.
4. Record each canopy or foliar species (including DT, DS, DF, DG) only once in the foliar and canopy columns, even if it is intercepted several times.
5. If you can identify the genus, but not the species, either use the PLANTS database genus code (http://plants.usda.gov) or record a number for each new species of that genus. ALWAYS define the functional group for the unknown genus at the bottom of the subplot checklist form.
6. If you *cannot* identify the genus, refer to the unknown codes. Collect, press, and label the unknown species (do NOT collect the species on the transect, find it somewhere else in the area). On the subplot checklist identify unknown species code used and describe sample.
7. Record herbaceous litter as “L,” if present. Litter is defined as dead stems and leaves that are part of a layer that comes in contact with the ground, and are usually gray in color. Record “W” for detached woody litter that is greater than 5 mm (or ~1/4 in) in diameter and in direct contact with soil. Litter and Woody Litter are the lowest foliar layer recorded.
   1. **Litter** = non-living plant or animal material that rests loose on top of the soil surface, potentially capable of being moved by water or wind. Detached woody material qualifies as litter when it is less than 5mm (1/4 inch) diameter.

**Line-Point Rules (3)**

* If the pin does not contact a shrub or tree, but the point on the line is surrounded (within the perimeter of the canopy) by shrub/tree vegetation from the same shrub/tree species with a gap in the vegetation >5 cm for shrubs and >50 cm for trees, then record a canopy cover hit.
* If the pin contacts the shrub/tree species anywhere on that point do not record a “canopy” hit, but record a “foliar” hit where the pin contacts the shrub/tree species (you cannot have the same species recorded as a “canopy” and “foliar” hit).
* If the shrub/tree is dead (has no leaves or needles) and cannot be identified to species record it as a dead shrub (DS)/dead tree (DT).
* If there is a foliar hit of another species over a canopy hit, still record the canopy hit in the “canopy” column.

1. Record whether the pin intercepts a plant base or one of the following in the “Soil surface” column.

**R** = Rock (> 5 mm or ~1/4 inch in diameter)

**BR** = Bedrock

**EL** = Embedded litter

* + - * 1. **Embedded litter** = non-living plant or animal material that is visible at the soil surface, wedged or contained around its edges by soil or rock which limits its potential of being moved by water or wind.

**D** = Duff

**M** = Moss

**LC** = Lichen crust on soil (lichen on rock is recorded as “R”)

**S** = Soil that is visibly unprotected by any of the above

**Line-Point Rules (4)**

* If the pin intercepts a live plant base record the plant code for soil surface. This is the only time one species may be recorded twice for one point.
* For unidentified plant bases, use the designated unknown code determined for the subplot.
* If the pin hits the base of a dead plant, enter code DT, DS, DF, or DG appropriately for the soil surface code.
* Record embedded litter as “EL” where removal of the litter would leave an indentation in the soil surface or would disturb the soil surface. Record duff as “D” where there is no clear boundary between litter and soil and litter is not removed during typical storms (occurring annually).

**Herb Density (Datasheet 5)**

* 1. Locate the 7, 15 and 23 m transects
  2. On each of these transects place a 0.25 m2 quadrat on the graduated side of the tape beginning at every odd meter starting at 1 m.
  3. Count and record individual plants in the following life-form categories: perennial bunchgrass, short perennial bunchgrass, non-rhizomatous perennial forb, and annual exotic grasses.
  4. Record presence or absence of rhizomatous perennial grasses, rhizomatous perennial forbs, and annual exotic forbs.
  5. Count Pinion and Juniper, Artemisia, and Purshia that are under 5 cm in height and record by species.
  6. Record counts for each category separately

**Shrub Density (Datasheet 6)**

1. Shrub Density will be sampled on the 7m, 15m, and 23 m transects.
2. Using a meter pole, walk along each side of the transect and count the number of shrubs within 1 meter of the tape.

**Shrub Density Rules**

* Do not count shrubs < 5 cm tall.
* Shrub density counts are recorded by species in two different size classes (5-15 cm and >15 cm) for dominant shrubs
* Other common shrubs > 5 cm will also be counted and recorded by species but are not separated by height size class.
* All other uncommon shrubs > 5 cm are lumped and counted together into a ‘non-dominant shrubs’ category.
* Trees are counted only if they are between 5-50 cm. Record by species.
* All dead shrubs and trees (5-50 cm) will be counted and lumped into a ‘dead’ category.

**Shrub Volume (Datasheet 7)**

1. On the 15-m transect, measure height of the tallest leaf **(not including the inflorescence)**, longest diameter and the perpendicular diameter to the nearest cm of **all shrub species** >15 cm in height within 1 of 3 nested circular frames (1-, 2-, or 3-m radius) at every 6m along the transect beginning at the 3-m point (3m, 9m, 15m, 21m, 27m).
2. Each shrub species will have its volume measured in one of three different size circular frames (1-m, 2-m or 3-m radius).
   1. For each major species, the observer will determine the frame size needed to measure approximately 15 individuals of that species across all 5 frames.
   2. That frame size will be recorded and used for that species at each of the 5 sample points along the entire length of the transect.
   3. If fewer than 10 shrubs are measured, in total for the 5 sampling points, using this frame size, then the measurements should be repeated with the next size larger frame size. If 10 or more shrubs are measured, then record the measurements of all individuals. (Note in some cases this may exceed 15, but it is necessary to measure all individuals of that species in each of the 5 frames even if they exceed 15.
   4. Measure all minor species within a 3-m radius of each point.
3. Only individuals rooted >50% within the quadrats will be sampled.
4. Do not measure dead shrubs or shrubs with < 10% live canopy.

**Herbaceous Biomass Quadrats (transect 11 only) (Datasheet 8)**

* + - 1. Three components of herbaceous biomass will be collected:

1. Current year’s growth (includes current year’s biomass that has senesced)
2. Standing dead (last year’s biomass)
3. Surface litter (Note: Surface litter includes previous years’ shrub foliage).
   * + 1. Subplots will be sampled with 15, 50x50 cm quadrats. Samples will start at the 2m mark and go thru the 30 m mark.
       2. Measure the height of tallest live forb including reproductive structures.
       3. Measure the leaf height (not the reproductive structure) of the tallest grass and record separately. If the tallest grass is *Bromus tectorum* measure the droop height.
       4. Clip current year’s and standing dead biomass in each 50x50 cm quadrat to 1-cm height. Separate the current year’s and standing dead biomass and place into separate buckets.
       5. Composite all quadrats’ current year’s and standing dead biomass from the transect into two different buckets.
       6. Collect and composite surface litter from each quadrat in a separate bucket.
       7. Save in separate paper bags for drying for 48hrs at 50 ºC.
       8. Weigh current year’s biomass (CYB), standing dead biomass (SD), and litter (Herb L) to the nearest gram, and record weights on the sample bags and the subplot check sheet.
       9. Mark all sample bags with the appropriate site, treatment, subplot, and sample type (CYB, SD, Herb L).
       10. Following drying, record dry weights of each current year’s, standing dead biomass and surface litter subsample.

**Tree Litter, Duff, and Soil Measurements (Datasheet 9)**

1. Six trees in each subplot will be sampled
2. Find the two trees that are closest to the center point of the subplot and the one tree that is closest to each corner for a total of six different trees. Use at least one pinyon and one juniper for litter and duff measurements, if possible.
3. The trees may be of different species (excluding mountain mahogany). *Record the species of each tree*.
4. Place 25 X 25 cm quadrats beneath each tree parallel to the line of the 30 m transect. Randomly choose which side of the tree the samples will be taken.
5. *\*\**For ONE tree of EACH species found in the subplot, collect three core samples of material (litter or duff) representing the contact layer directly beneath the shredded material (in the control subplots top layer) using the soil core.
   1. Using the soil core, remove the top 2 cm of material, repeat two more times at different locations within the same quadrat for a total of 3 samples.
   2. Place the 3 samples into one appropriate marked quart-size Ziploc bag. Scrape the soil corer clean with a trowel or spatula between each sample
   3. Place sample bag into a cooler containing blocks of ice.
6. For each of the six trees separate litter and duff from each quadrat, weigh and record (wet weight).
   1. **Duff** = decomposed and unrecognizable non-living plant or animal material that lies beneath litter or embedded litter, unexposed to light, not yet decomposed to soil form.
7. Measure and record depth of litter and duff at each quadrat location.
8. Collect one sample of duff and one sample of litter (~200 grams) from EACH of the tree species used in step 4. Weigh sample and record weight on bag and subplot checklist.
9. Place the litter and duff back in the quadrat after you have completed all of the steps for this section.
10. Label bag with site, treatment, subplot #, date and bring back to lab to dry (48 hrs, 50°C).

**Tree Litter and Duff Rules**

* The tree canopies must be greater than 2 m in diameter in order to sample.
* If the tree is 2-5 m in diameter take samples from the base of the tree and at ~1/3 of the canopy out from the base.
* If the tree is >4 m in diameter take samples from the base, 1/3 of the canopy and 2/3 of the canopy out from the base.
* If one of the trees closest to a certain point was already chosen as the closest tree to another point find the next closest tree.
* If you have fewer than six trees (>2 m) in a subplot collect samples from all those trees but do not sample outside the subplot. Trees must be rooted within the subplot.

**Mineral Soil Measurements (use one pinyon and one juniper when possible) (Datasheet 12)**

1. Using the sample tree(s) that was used in step 4 above, collect mineral soils:
   1. **Mineral soils = soil composed of sand, silt, or clay and is not organic matter (there should be no duff on the soil surface, if there is, sweep it away with your hand).**
   2. Soils will be collected at ~1/3 of the canopy and at the canopy edge
   3. Soils will be collected at two depths: 0-2 cm and 15-17 cm.
   4. Each collected soil core should be 2 cm deep X 5 cm diameter.
   5. Three samples will be removed for each depth at each location.
2. Depth 0-2 cm:
   1. Once the core is sitting on top of the mineral soil surface, use a mallet to pound the core into the ground **(the soil core has a beveled edge at 2 cm from the base of the core and may be used to visualize a 2 cm soil depth)**.
   2. Excavate the core with a shovel or trowel and the spatula (slide the spatula beneath the core). **The soil in the core needs to fit the core dimensions as close as possible. Take care to remove only intact soil cores.**
   3. Place the soil from the core in the appropriate quart size Ziploc bag and scrape the soil corer clean with a trowel or spatula (there is a specific bag for each depth collection).
   4. Remove all excess air from each bag of soil by partially sealing the bag and rolling the bag from the bottom then zip the bag securely closed. (We need to avoid letting water into the bags from the cooler so make sure that it is completely closed)
3. Depth 15-17 cm:
   1. Dig with a shovel a hole about the size of the 25 X 25 cm quadrat to the soil depth of 15 cm from the soil surface.
   2. Follow the above procedure under depth 0-2cm (a-d).
4. Repeat the entire process for the canopy edge sample on the same tree.
5. Collect Interspace Soils (once per subplot):
   1. Collect interspace samples >1 m away from canopy edge of trees.
   2. Try to avoid taking the interspace samples around any vegetation.
   3. Repeat the above procedures for the two depths (0-2 cm and 15-17 cm).
6. Store all Ziplocs with soil in a cooler containing blocks of ice.
   1. Take precautions by emptying water from the cooler each night to even more avoid getting water in the soil bags.
   2. Keep the soils cold in the field and bring them back to the lab as soon as possible:
      1. Plan your week accordingly so the soils are in the cooler for only a short period of time (preferably only 2-3 days).
      2. Minimize the amount of time between sampling and placing the soils in the cooler.
      3. Always keep the coolers in the shade.
      4. All of these precautions are even more important if the soils are moist. Soils will start to change if the samples are both moist and warm.
7. Immediately when you return from the field place the entire coolers in 884 WIDB (labeled 4°C) on the 8th floor.

Tree diameter measurements

1. For the two trees (one pinyon, one juniper) where soil samples were collected:
   1. Measure tree height, crown base height, longest crown diameter, and the perpendicular diameter to the nearest dm. Recorded tree measurements on the tree litter spreadsheet.

**Soil Rules**

* If the core does not want to penetrate the soil shift the core over a few cm and start again
* If there are small rocks in the sample do not toss them out. We want everything in the core
* However, if the core is mostly rocks resample

**Tree Height and Canopy Diameter (Datasheet 10)** *(only on control sites with the four exceptions below)*

1. Measure tree height, crown base height, longest crown diameter, and the perpendicular diameter to the nearest dm.
2. If the tree is dead, measure height only and record in the “Dead” column.
3. Take these measurements for every tree, including mountain mahogany, that is over 50 cm in height and is rooted in the subplot.
4. Keep track of the trees measured by working your way up and down the transect interspaces.

**Tree Height Rules**

* If tree canopies of the same or different species are inter-mingled, each tree canopy will be measured separately even though they overlap.
* If a tree canopy is completely surrounded by a more dominant tree canopy of the same species, the canopy will be measured as a single tree.
* Multiple stem trees will be measured as a single tree and if a stem is within 1-m of a mature tree, the trees will be pooled as a single tree.

**Bullhog treatments without pre-treatment NAIP imagery**

*(Government Creek South, Ray Mesa, South Creek and South Hills)*

1. Estimate pre-treatment tree cover on bullhog plots:
   1. Measure the longest crown diameter and the perpendicular diameter to the nearest dm for each tree (identify and measure each tree stump rooted within the plot).
   2. Use tree needles as a good indication of the original tree canopy drip line; use your best judgment on where the tree crown would be.
   3. Be aware that wood chips may be scattered during the bullhog process so will not be the best indication of crown diameter.

**Plant Species List (Datasheet 11)**

* 1. Spend 10 minutes walking the entire subplot.
  2. Record all the plant species found within the subplot
  3. Give an abundance rating for each species; An abundance ratingis a qualitative estimate of the relative abundance of a species in the subplot primarily based on the proportion of total plant cover (composition based on cover).

**5=Dominant,** cover >50% of the total plant cover. Only one plant can receive this rating in a subplot. A subplot where no plant is clearly the most abundant than no 5 is assigned.

**4=Co-dominant,** plant cover is ¼ - <½ of total plant cover. More than one plant can receive a rating of 4. Annual and perennial forbs would rarely be a co-dominant.

**3=Common,** the species is easily seen without walking around. Plant cover is 5 to <25% of total plant cover, or if cover is <5% than the plant has a high frequency and density throughout the plot (e.g. small annual forbs)

**2=Sparse**, scattered plants in the plot that are easy to spot when walking around. Plant cover is < 5% of the total plant cover.

**1=Rare,** 1-2 plants in the plot, you have to hunt around the plot to find plant.

**1000-hr fuels in field without collection (Datasheet 13)**

1. # of transects measured in field
   1. Phase I: 5 transects – 2, 7, 15, 23, 28
   2. Phase II: 3 transects – 7, 15, 23
   3. Phase III: 3 transects – 7 and 23 only
2. 2 m belt transect (1 m on each side of transect line)
3. Belt transect extends up 2-m to include dead branches on live or dead shrubs and trees
4. For each 1000 hr piece found:
   1. A 1000-hr piece, is a piece of fuel with its widest diameter > 3-in

b. Record:

i. At large end of fuel, record widest diameter and narrowest diameter at the same point

ii. At small end of fuel, record widest diameter and narrowest diameter at the same point

iii. Length between large and small end measurement points

iv. Species  
 v. Decay class: sound -or- severely weathered dry rot with very deep venation

The example for dry rot is a downed tree skeleton from chaining 50-yrs earlier.

**1000-hr fuels Rules**

* All measurements are in centimeters and where possible recorded to 0.5 cm accuracy.
* Measure diameters perpendicular to the central axis of the fuel.
* In the untreated Control plots only, completely detached needles or leaves of any color do not need to be collected unless they are connected to piece of fuel that is collected.
* In any treatment, do not collect decades-old black needles or leaves and do not dig through undisturbed black needle mounds for pieces of fuel unless the needle mound has been disturbed by the bullhog treatment and during the bullhog treatment new pieces of fuel were mixed or pressed into the black needle mounds.
* Measurements will be used to build mathematical tapered cylinders or sections of very long and slowly tapering cones. The two diameters on each end of a fuel are required to build tapered cylinders based on the average diameter at each end of a fuel.
* If a tapered cylinder or cone cannot approximate the shape of the 1000-hr fuel in question, then measure the fuel in consecutive sections. An example of when measuring multiple sections separately would be most critical is for larger 1000-hr fuels like a partially masticated tree trunk that had very different shapes along its length. Please remember that each section of a large fuel has to have every Excel cell filled in for the entire row in the Excel spreadsheet.
* If an end of a fuel is round like a circle then only one diameter measurement for that end is needed.
* The small end of a 1000 hr fuel terminates when the average of the widest and narrowest diameters at the small end becomes less than 3-in even though the smaller end of the 1000-hr may in reality continue on into a 100-hr size class.
* The diameter measurements for the end of a fuel piece crossing the belt-transect border would be taken at the border’s edge.
* Try to avoid visual parallax when measuring diameters, which increases with increased fuel diameter.
* Please use calipers
* These methods do not replace any other method.

**Subplot Checklist**

1. Following data collection at the subplot, ensure that all data are accounted for by initialing the appropriate box on the subplot checklist. Make sure the wet weights have been recorded for herbaceous CYB, SD, Herb L, Tree Litter and Duff on the checklist and the sample bags.