Plot protocol in piñon-juniper woodland

Our monitoring handbook, which we distribute as part of our monitoring classes, describes in detail our protocol for measuring forest and woodland vegetation. The general procedure is the same for ponderosa pine, mixed conifer, and piñon-juniper. The difference is how we measure diameter. The procedure described here first covers the general way we take monitoring plots, then gets specific on how to deal with multi-stemmed woodland species.

Plot Description

This data sheet, as the name implies, contains mostly descriptive information.

Plots are established using a random point location with project-specific boundaries e.g. stand boundaries, treatment areas, vegetation types, etc. All plots are marked with a 1-foot piece of ½ inch rebar that serves as plot center. This location is updated in a GPS devise to ensure greater location accuracy. Plots must be moved one chain (66 ft) from their original, intended location if they are within 75 feet of a road. We take plots of fixed radius. From plot center pin flags are placed at 11.78ft (11' 9") and 37.24ft (37' 3") in all four cardinal directions (N, E, S, W) to give visual aids for the two plots ($1/10^{th}$ ac and $1/100^{th}$ ac, respectively) whose purposes are described below (Figure 1).

A photo series is taken: one photo to each of the cardinal directions, with a white board held at the outer edge of the plot, and an additional photo from one chain north which looks back to plot center.

Slope, aspect, coordinates, elevation, date, and time are recorded for each plot. A comment field is available on all datasheets and we encouraged all observations, including species, land use impacts, presence of fire scares, etc. to be documented.

Overstory forest structure

All trees taller than breast height ($\geq$ 4.5 ft. and $\geq$ 1.0 in. DRC) are measured within the $1/10^{th}$ acre plot (37.24 ft. radius) circular, fixed area sampling plot (Figure 1). Species, condition, diameter at root collar (drc), total height, and live crown base height are recorded for each tree located within the plot. Trees are recorded starting from the north azimuth line and moving clockwise, like spokes of a wheel from plot center. In dense stands, we find it helpful to flag the first tree measured to keep the crew oriented.

Tree regeneration (trees $<$ 4.5 ft. or $<$ 1.0 in. drc) is measured on the nested $1/100^{th}$ acre circular plot (11.78 ft. radius) and species, condition, and height class ($>$0-0.5 ft; $>$0.5-1.5ft; $>$1.5-2.5ft; $>$2.5-3.5ft.; $>$3.5-4.5ft; and $>$ 4.5ft but $<$ 1.0in dbh/drc) are recorded for each seedling or sprout. Shrubs are measured on the same nested subplot and species, condition and height class (($>$0-0.5 ft; $>$0.5-1.5ft; $>$1.5-2.5ft; $>$2.5-3.5ft.; $>$3.5-4.5ft) will be recorded for each stem. Overstory canopy cover (density) is measured facing out at the four small-plot pin flags, along the perimeter of the nested subplot, using a spherical densitometer. In this way, each reading will be spaced 90 degrees apart.

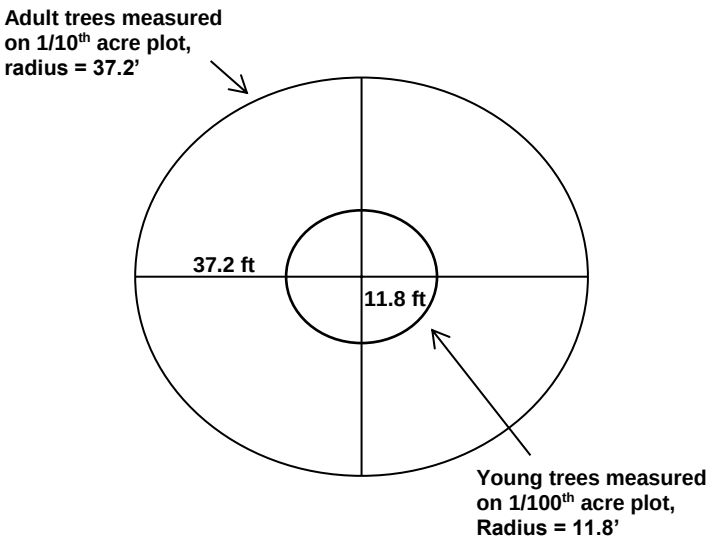

Figure 1. Schematic of plot layout for overstory (1/10th acre) and understory regeneration (1/100th acre) plots.

Following USFS practice, piñon and juniper diameter is measured at the root collar (DRC) rather than at breast height (DBH). Both piñon and juniper can be either single- or multi-stemmed. Piñon is usually single-stemmed, and juniper is usually multi-stemmed. A single plant that has multiple stems presents challenges to calculating biomass, average basal area, etc. For an individual plant, we overcome these problems by measuring height and diameter of each stem, using these to calculate an equivalent DBH for each tree. Each step will be explained below.

Safety should be mentioned. Onion-shaped junipers are common, and getting past the outer branches of a large specimen to be able to measure the stems at the root collar can be a challenge. The crew member doing this must wear eye protection and work gloves as protection from sharp branch stubs, and watch for rattlesnakes.

For each multi-stemmed tree or shrub:

- Indicate on the data sheet which stems belong to this tree. Note that this indication needs to be flexible, since number of stems measured often is not able to be determined until an observer gets under the tree.
- In some cases when a group of single stems emerge in a cluster from the ground, the observer will need to make a judgment call if they are separate plants growing close together, or multiple stems originating underground from the same root crown. Deciding one way or another is important, but not critical to successful monitoring.
- Maintain the same clockwise progression within the multi-stemmed tree that you maintain in the plot as a whole.
- Diameter is measured at the root collar. Root collar location is something of a judgment call, but is never more than six inches above the ground. In most cases, the stem will be measured

just above the ground line. In some cases, especially with an individual's largest stem, the stem will taper very quickly within an inch or two of the ground; in that case, measure DRC just above the top of the taper.

- Every effort should be made to minimize the number of stems per tree. Measuring as low as possible does this. Once again, numbers of stems per tree depends somewhat on the judgment of the observer.
- For each stem 1-inch in diameter or greater, record DRC, height, and height to base of crown. We use calipers to measure DRC; stems are often distorted to the point that two diameter measures need to be taken and the average recorded.
- An alternative to recording the height of each stem is to record one average height for the tree. This practice is fine, but care should be taken that it is representative.
- In certain junipers, height to base of crown can vary greatly from stem to stem. Since height to base of crown is a measure of susceptibility to fire, record the lowest height observed for the tree. The minimum value is one foot.
- Continue to the next tree on the plot.

The above example is appropriate for any multi-stemmed tree. While the current discussion is about Piñon and Juniper, the field procedure is the same for oak.

Calculations

Diameters of multi-stemmed trees must be converted to a single diameter before any calculations. That new indicator is called the *equivalent diameter*. Its calculation is described below. In addition, in order to compare these trees to trees with dbh measurements, equivalent DRC is converted to equivalent DBH. The entire process, from raw field data to equivalent DBH, is taken from Chojnacky and Rogers (1999).

The following conversion equations can be used to convert from DRC to DBH for single and multi-stemmed piñon and juniper individuals:

$dbh = -2.6843 + 1.0222*(drc) + 0.7433*(stem) + 0.7469*(piñon) – 0.0399*(drc_P)$

where,

dbh = diameter at 4.5 ft. above the ground line of live and dead stems 1 in. and larger.

drc = diameter at root collar of all live and dead stems 1 in. and larger.

diameter = $\sqrt{\sum_{i=1}^{n} d_i^2}$

n = number of live and dead stems at drc with diameter 1 in or larger

d_i = stem diameter

stem = 1 for trees with one stem (n = 1) at drc, 0 otherwise

piñon = 1 for *piñon* pine species, 0 otherwise

drc_P = drc for piñon pine species, 0 otherwise

Treatment Methods

Treatment protocols for each of the five PJ-types recognized by NMFWRI are based on the following principles:

- Ecological restoration is guided largely by the concept of natural range of variability (or reference condition)
- Ecological restoration is the act of moving an ecosystem back to within its natural range of variability through management actions.
- Disturbance plays a principle role in maintaining ecosystem structure and function and defining reference conditions
- The difference between reference conditions and current conditions is used to define restoration targets and evaluate treatment success.

Grasslands:

- Fire was the primary disturbance controlling tree establishment on sites with a grassland reference condition. Trees were rare and occurred in microsites such as rock outcroppings that escaped fire.
- An essential clear-cut is appropriate for sites that were historically grasslands. Thin all trees leaving only those were it is judged are located in what would likely have been a microsite and not effected by fire. If trees are to be left for wildlife to provide shade for livestock, leave the largest best formed and healthiest trees.

PJ Savanna or Juniper Savanna

- Thinning in site with savanna reference conditions should aim to reestablish a diverse matrix of grass and forb understory plant communities.
- Both group-tree selection and uneven-aged single tree selection could be used to treat these sites.
- Groups should be small, 2 – 10 trees per group with no more than 30 trees per acre. Favor pinon over juniper and choose the best formed and healthiest trees to leave.
- If single tree selection is used identified the leave trees first and remove around these.

PJ woodlands:

- Three woodland types are recognized: 1) PJ persistent woodlands, 2) PJ open woodlands, and 3) PJ shrub woodlands. For each of these woodlands fire occurred infrequently and was typically of higher severity.

- Regeneration is not usually an objective in PJ woodland types. Instead, the goal is to reduce the risk of wildfire by decreasing canopy continuity throughout the stand.
- Use group selection cutting. Work towards balance of size (age is difficult to determine for Juniper) classes. Openings should range from 1/10 to 3/4 acre is size. When choosing which trees to cut and which trees to leave, favor pinon over juniper. Choose the best formed and healthiest trees to leave.

Citations

Chojnacky, David, and Paul Rogers. 1999. Converting tree diameter measured at root collar to diameter at breast height. Western Journal of Applied Forestry 14 (1): 14-16.

Link to NMFWRI Forest Monitoring Protocols
http://nmfwri.org/resources/projects/project-resources-1/NMFWRI_Forest_Monitoring_Protocols.pdf