Protocol for Monitoring Understory Plant Response to Front Range Collaborative Forest Landscape Restoration Program (FR-CFLRP) Treatments

Developed by Brett Wolk and Elizabeth Ertl (CFRI), and Paula Fornwalt (RMRS)

Sampling Objective:

*Collect understory vegetation data using a Before-After-Control-Impact (BACI) design to analyze the effects of various Front Range CFLR treatments. Data collection is to occur 1 – 2 years pre-treatment, 1 – 2 years post-treatment, 4 – 5 years post-treatment, and 8 – 9 years post-treatment.

In 2010, the Arapaho – Roosevelt (AR) and Pike – San Isabel (PSI) National Forests were awarded a Collaborative Forest Landscape Restoration Program (FR – CFLRP) grant to facilitate the implementation of restoration treatments in ponderosa pine dominated forests. Initial monitoring plans and questions focused on evaluating restoration treatment impacts on overstory trees, tree regeneration, and fuels. Additional monitoring questions and a monitoring plan were developed in 2014 to include a strong emphasis on evaluating understory plant impacts (and a separate wildlife monitoring component).

Monitoring efforts will help answer the following questions:

1. Have restoration treatments increased or maintained total native plant cover and diversity?
2. Have treatments increased or maintained the cover and diversity of native graminoids, forbs, and shrubs?
3. Have treatments increased the cover and diversity of native early successional species?
4. How have treatments increased or maintained the cover of key native plants (to be defined by ARNF/PSINF personnel)?
5. Have treatments minimized increases in total exotic plant cover or diversity?
6. Have treatments minimized increases in the cover of exotic species of concern (e.g., noxious weeds)?

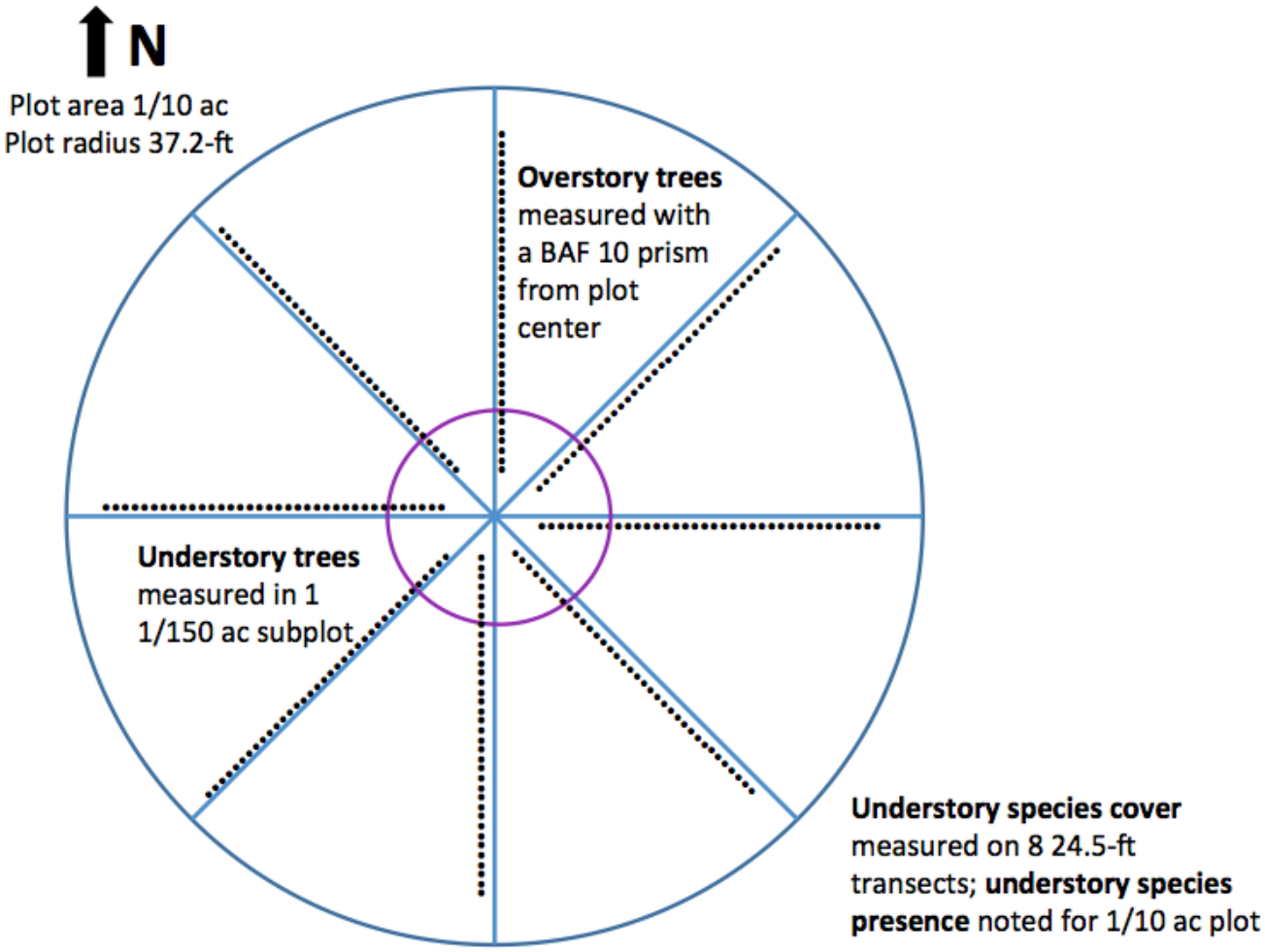
Plot Selection:

- Exclude areas that appear to be riparian or in drainages, active recreation areas/roads. Keep plot center at least 100 feet from excluded areas.
- Overstory and understory physiographic settings and plant communities should be similar between treatment and control areas.
- Land use histories or past treatments should be very similar between treatment and control areas.
- Slopes, aspects, and elevations should also be similar between treatment and control plots.

Sample Methods

Plot Layout:

1. Randomly locate the plot origin (center) within the desired sample area. Use GPS/GIS technology if available, or a random number table with numbers 0-359 can be used to choose a random direction and then a random distance to walk.
    a. If a randomly generated GPS point falls in an area that is not a suitable sample area (e.g. on a road, riparian, treatment boundary, etc.), use the random number table to choose a direction and distance to move the point to a suitable area. If a suitable area cannot be found, use another random point generated in a GIS.
2. From plot origin, establish 8 transects in the cardinal (0°, 90°, 180°, 270°) and ordinal directions (45°, 135°, 225°, 315°) using a **declinated** compass (set north to positive 9 degrees for Colorado – 9 degrees to the east). You will use 4 X 100-ft tapes to establish these. To ease calculations, center the 40-ft mark of all 4 tapes over the plot origin and extend the tape out to 80-ft. Colored tape will be marking the plot center and transect ends, as well as the understory plant measurement areas on each 100-ft tape.
    a. If 100-ft transect tapes are not marked with colored tape, add a small strip of colored around the transect tape at 2.8-ft, 9.5-ft, 34-ft, 40-ft (center), 46-ft, 70.5-ft, and 77.2-ft.
3. Establish one 1/150th-acre fixed radius (9.6-ft radius) subplot, centered on the plot origin.



Origin Sample Point:

1. **Location**
    - **a.** Using a GPS unit, record the location (UTM's) and elevation at the origin point. Use the **NAD83 map datum** for recoding all points.
        - **i.** To locate plots post-treatment, leave three monuments (nail and washer painted yellow, silver tag). One at the origin, and one at 37.2-ft along both the North and East transects.
        - **ii.** Wrap a small piece of pink flagging around the top of each nail. If flagging is missing in post-treatment years, re-flag nails.
        - **iii.** Use an aluminum tree tag and attach to each nail with metal wire. Inscribe "CFLR Understory Permanent Research Site, <Date>, <Center, North, or East>".
        - **iv.** Wrap pink flagging around the first live tree that is in the clockwise direction of the North transect. Also, wrap pink flagging around the largest tree in the plot (if northern most tree is also the largest, then flag the second largest tree). Tie the flagging knots facing towards plot origin.
    - **b.** Using a **declinated** compass, record the hill-slope azimuth in degrees (0-359) within the 1/10th acre plot.
    - **c.** Using a clinometer, record the slope to the nearest percent within the 1/10th acre plot. Take slope measurements from plot center both downhill and uphill, and then record the average slope of the two measurements.
    - **d.** Take note of any signs of past disturbances and record the start and end time of data collection for each plot.

2. **Photo's**
    a. Standing at the plot origin, take a series of 6 photos for each plot. Photos will be used to describe understory vegetation conditions and to help locate the plots post-treatment.
        Suggested photo sequence:
        i. Take 3 photos along the north transect, one of the ground level (including the plot origin out to 10-ft mark on the North transect), one at breast height, and one of the forest canopy.
        ii. Take 3 more photos at breast height for the east, south, and west transects.

3. **Tree Overstory (variable radius plot)**
    a. Record the basal area prism or angle gauge size and units. For the CFLR Understory work, all plots should use a **10 BAF** prism.
    b. Standing at the plot origin, use a basal area prism or angle gauge to record the basal area of the variable radius plot for all live and dead trees greater than 4.5 feet tall. If a tree is a 'hit', include it in the basal area count and mark that tree for further measurements.
    c. For each 'hit' tree included in the basal area count, record:
        i. Tree species
        ii. Live or dead
        iii. Diameter at breast height (DBH) to the nearest $1/10^{th}$ inch
    d. For standing dead trees taller than DBH (snags) that are included in basal area count, also record decay class on a scale of 1-3.
        1. Decay class 1a *with needles* = recently dead trees, top intact, needles/foliage and fine branches present.
        2. Decay class 1b *without needles*= recently dead trees, top intact, fine branches present.
        3. Decay class 2 = snags have coarse branches and bark present, but fine branches and foliage have fallen off.
        4. Decay class 3= snags are rotten, bark not present. Very few if any branches remain.

<u>$1/150^{th}$ – Acre Subplots:</u>

1. **Tree Seedlings**
    a. For any trees less than 4.5 feet tall that are rooted within the subplot (9.8-ft radius), record the species and number of individuals in each height class.
        i. Height Classes: 1 = 0"-4"; 2 = 4.1"-18"; 3 = 18.1"-30"; 4 = 30.1"-54".

<u>37.2 – Foot Transects:</u>

1. **Understory Vegetation and Substrate Cover**
    a. Establish 8 transects from the plot origin at the azimuths of 0°, 45°, 90°, 135°, 180°, 225°, 270°, and 315°.
    b. Record any understory plant present at 25 evenly spaced points (every 1-foot) on all 8 transects. Begin counting at 6-ft from the origin through 30-ft for a 24-ft section along each transect.
        i. A buffer around the center reduces trampling and autocorrelation of counts, and buffering the ends ensures vegetation estimates are within the plot area.
    c. Identify plants to the species level. If unable to identify a plant, give the plant an unknown number and name. Show the plant to everyone on the crew to ensure that consistent unknown names are used. Collect a specimen from outside the plot for later identification in the lab.
    d. If more than one species is visible at a sampling point record them all (i.e. kinnickinnick, mountain mahogany, Douglas-fir). Record the top most vegetation as the top hit, and then other species of shorter stature as bottom hits. This allows calculation of total percent cover as well as relative species cover.
        i. Include large shrubs, tree branches, and live tree trunks only when they are encountered below 4.5ft.

e. Record forest floor substrate at each point as well. Each transect should have exactly 25 substrate counts, i.e. 1 substrate for every point measured.
   i. Substrate categories include: litter/duff, soil/gravel, rock (>0.5 inch), fine fuels (1/10/100hr), Coarse fuels (1000hr), moss/lichen, woody basal, and herbaceous vegetation basal.
   ii. If a substrate category is encountered suspended higher than ~1 inch above the ground, record that substrate as "in air" and then record the substrate on the forest floor. For example, if a log is suspended above the ground with a grass growing under it, and pine needles are under the grass, you would record 1000hr in air, Muhlenbergia montana, and then litter as the substrate. Only use the "in air" category if you can see potential growing space for plants under the suspended substrate. This measure will be used to estimate woody debris abundance and compare different slash disposal techniques.

f. Tally the number of occurrences of each species and substrate and divide by 200 to calculate percent cover for each plot.

2. Litter and Duff Depths

a. At regularly spaced intervals along the N, E, S, and W transects, measure litter and duff depths to the nearest 0.25-inch. Measurement points are 10-ft, 20-ft, and 30-ft from plots center at each of the four transects.

3. Tree Cover

a. Using the densitometer scope, at every foot along the North-South transect record cover of any **live** tree taller than 4.5-ft (DHB). Begin counting at 37-ft on the South transect, and count every 1-ft until you reach 37-ft from plot center on the North transect for a total of 75 measurements (37 counts each side of the plots origin, plus one count over the plot origin). Stand directly over each point along the transect, look straight up through the densitometer scope and record when tree (foliage or trunk) is encountered. For each hit, record the tree species.
   i. If multiple live tree species are encountered at one point, record the tree species lowest in height at that point.

1/10th – Acre Plot:

1. Understory Vegetation Presence

a. Systematically search for and record any additional plant species present in the 0.1-acre plot that were not recorded as cover hits on the 8 transects surveyed for percent cover.

b. Identify plants to the species level. If unable to identify a plant, give the plant an unknown number and name. Show the plant to everyone on the crew to ensure that consistent unknown names are used. Collect a specimen from outside the plot for later identification in the lab.

c. If any exotic species of concern are found during this search, estimate their cover in the 0.1-acre plot as rare (>0 – 1%), common (2 – 10%), abundant (11 – 50%), or very abundant (51% +).

Gear List:

- ✓ Data sheets and unknown plant sheets (regular and rite in the rain)
- ✓ GPS unit and batteries
- ✓ Camera and charger
- ✓ Maps (quads and plot maps)
- ✓ Walkie-talkie and charger
- ✓ First aid kit, bug spray, sunscreen
- ✓ Compass
- ✓ Clinometer
- ✓ Marker board
- ✓ Monuments (large nails, whiskers)
- ✓ Hammer
- ✓ Clipboard
- ✓ Pencils, pens, sharpies, dry-erase markers
- ✓ Prism (BAF 10)
- ✓ Diameter tapes
- ✓ 4 X 100-ft tapes with **1-inch** markings
- ✓ Paper bags for unidentifiable field specimens
- ✓ Flagging
- ✓ Small shovel
- ✓ Pin flags
- ✓ Chaining pins (x10)
- ✓ Metal dowel with seedling height class markings
- ✓ Rope (measured out to 9.6-ft for tree regeneration subplots)
- ✓ Densitometer
- ✓ Loggers tape
- ✓ Species lists and field guides
- ✓ Plant press
- ✓ Water cooler