Updated Forest Service Common Stand Exam (CSE) monitoring techniques for CFLR project

The following are the changes (shown in red), recorded on 3/21/12, regarding Forest Service CSE data collection methods for CFLRP projects.

Also incorporated are suggestions for understory monitoring made by Paula Fornwalt of the USFS-Rocky Mountain Research Station and the understory monitoring team on 5/8/2012.

NOTE: these changes only apply to new CFLRP CSE monitoring plots established. Original methods will be used in re-measuring existing plots.

Table 1: Plot "meta-data" to be collected during ecological monitoring for the Colorado Front Range CLFRP. Each of these variables will be collected for each monitoring plot.

Variable	Comments
Latitude/longitude	Or UTM as appropriate; from GPS
Slope	In percent
Slope position	Bottom, Lower, Middle, Upper, Ridge
Slope shape	Concave, Straight, Convex
Aspect	In degrees (also make note of declination)
Elevation	In feet; from GPS or map
Date	
Personnel on plot	
Start time/End time	Time spent on plot: for economic monitoring
Reference photographs	Four photos taken on cardinal directions
Permanently marked?	Whether plot center is permanently marked and how
Plot description	Brief description of the plot
Wildlife	Note instances of animal damage
Sampling Intensity	stratify treatment units by cover type, treatment type, and aspect- place at least 3 CSE plot within each stratified area
Control Stands	will evaluate time and cost impact of this in 2012- will set-up 4+ plots per cover type and aspect for major cover types to be treated within a project area

Table 2: Monitoring Protocols Table. Desired Conditions, restoration parameters, and monitoring details for the Colorado Front Range CLFRP. Note that several of the restoration parameters still need further details.

Desired Condition Restoration parameters	Desired trends	Variables to measure	Methods	At what point measured	Scale of analysis	Notes
Establish a complex mosaic of forest density, size and age (at stand and treatment scales)						
Tree Density	• Decreased basal areas	• Basal area	• Count all trees ~~≥2.5"~~ 5" diameter at breast height (DBH) in a variable radius prism plot (10 or 20 Basal Area Factor base type of prism used on expect tree numbers after treatment to ensure adequate trees (4-6/plots) will be measured post treatment) and scale up to per acre basis • Count all seedlings and saplings (<~~2.5"~~ 5" DBH) in three fixed radius ~~1/200~~ 1/250 ac (~~8.3~~' 7.45' radius) plot one centered on prism plot and one center at the end of each Brown's transect and scale up to a per acre basis. (see protocol diagram for sampling)	• Before treatment • After treatment • 5 to 10 years after treatment	• Treatment Unit	• Example data: 40-80 ft^2 per acre (1" DBH and above); however, expert review suggested this is site dependent
	• Decreased trees per acres	• Trees per acre	• Count all trees ≥2.5" diameter at breast height (DBH) in a variable radius prism plot (10 or 20 Basal Area Factor base type of prism used on expect tree numbers after treatment to ensure adequate trees (4-6/plots) will be measured post treatment) and scale up to per acre basis • Count all seedlings and saplings (<~~2.5"~~ 5" DBH) in three fixed radius ~~1/200~~ 1/250 ac (~~8.3~~' 7.45' radius) plot one centered on prism plot and one center at the end of each Brown's transect and scale up to a per acre basis. (see protocol diagram for sampling)	• Before treatment • After treatment • 5 to 10 years after treatment	• Treatment Unit	• Example data: 40-100 trees per acre (1" DBH and above); however, expert review suggested this is site dependent
Tree Sizes	• Increased Quadratic Mean Diameters	• Diameters at breast height for larger trees and root collar for seedlings and saplings	• Measure diameters at breast height (DBH) using diameter tapes on all variable radius plot "tally" trees and scale up to per acre basis • Count number of seedlings and saplings (<~~2.5"~~ 5" DBH) in three fixed radius ~~1/200~~ 1/250 ac (~~8.3~~' 7.45' radius) plot (seedlings = below BH; saplings = BH to <~~2.5"~~ 5" DBH) and scale up to per acre basis (see protocol diagram for sampling)	• Before treatment • After treatment • 5 to 10 years after treatment	• Treatment Unit	• Quadratic Mean Diameter (QMD) – Integration of stems per acre and diameters – representative of average tree size

Desired Condition Restoration parameters	Desired trends	Variables to measure	Methods	At what point measured	Scale of analysis	Notes
Tree Ages	• Increased ratios of old trees (>200 yrs) to transitional trees (150-200 yrs) to younger trees (<150 years).	• Tree ages	• Use visual references and morphology of all variable radius plot tally trees (RMRS-GTR-109 and 110) to define old/transitional/young trees and scale to per acre basis • Obtain dendrochronologically crossdated (or ring-counted) ages from increment cores as available	• Before treatment • After treatment • 5 to 10 years after treatment	• Treatment Unit	
Establish a more favorable species composition						
Tree Species	• Increased ratio of ponderosa pine to other conifers where appropriate	• Tree species	• Identify species of all variable radius plot "tally" trees and scale up to per acre basis • Count seedlings and saplings in fixed plot by species and scale up to per acre basis	• Before treatment • After treatment • 5 to 10 years after treatment	• Treatment Unit	
Establish a more characteristic fire regime						
Surface fuels	• Decreased litter and duff depths • Decreased or similar coarse woody debris	• Surface fuel conditions for development of surface fuel models	• Two Brown's transects (that measure log amounts and sizes, and litter and duff depths) running 50 ft from plot centers, alternating E/W, N/S in plots (see protocol diagram for sampling)	• Before treatment • After treatment	• Treatment Unit	
Fire behavior	• Mixed-severity that trends toward surface fire • Reduced crown fire potential at 90% weather as modeled in fire behavior models	• Tree heights, canopy base heights (CBH), canopy bulk densities (CBD), surface fuel models	• Canopy base height (CBH), canopy cover measured using Common Stand Exam methods • CBH, canopy bulk density (CBD), surface fuel models, and fire behavior afterwards modeled with plot and Brown's transect data, aggregated across landscape	• Before treatment • After treatment	• Treatment Unit • Landscape	• Example data: decrease in crowning and torching indices in pre- and post-treatment model runs

Increase coverage of understory plant communities (See Appendix A, page 37)						
Grass, forbs and shrubs.	• Increased cover by grass, forbs and shrubs • Decreased deep needle layers and bare ground.	• Ground cover by grass/forb/shrub functional groups • Presence and cover of key indicator species	• Average cover by functional groups (grass, forb, shrub, litter, rock, bare ground) measured on ~~350'point intersecttransects extendingfromplotcenters~~ five 1m^2 quadrats % by lifeform; record into % cover classes 0-1%, >1-5%, >5-25%, >25-50%, >50-75%, >75-95%, >95- defined classes. (see protocol diagram for sampling) • Average cover by individual or key indicator species (Appendix A Table 6) ~~asavailable (e.g.,whenbotanistisavailable)~~ five 1m^2 quadrats % by spp of Table 6 and 7 species; record into % cover classes 0-1%, >1-5%, >5-25%, >25-50%, >50-75%, >75-95%, >95- defined classes. (see protocol diagram for sampling)	• Before treatment • After treatment • 5 years after treatment	• Treatment Unit	• See Appendix A for a list of possible Tier 2 indicator species for monitoring
Noxious or invasive plant species	• Similar (or decreased) occurrence and cover of noxious or invasive plant species	• Presence and cover of invasive species	• Average cover by individual or indicator species (Appendix A Table 6) measured on ~~3 50'point intersecttransectsextendingfrom plotcenters~~ five 1m^2 quadrats % by lifeform and % by spp of Table 6 and 7 species; record into % cover classes 0-1%, >1-5%, >5-25%, >25-50%, >50-75%, >75-95%, >95- defined classes. (see protocol diagram for sampling)	• Before treatment • After treatment • 5 years after treatment	• Treatment Unit	• See Appendix A for a list of invasive species of concern

Appendix A: Understory species to monitor in lower montane restoration treatment areas

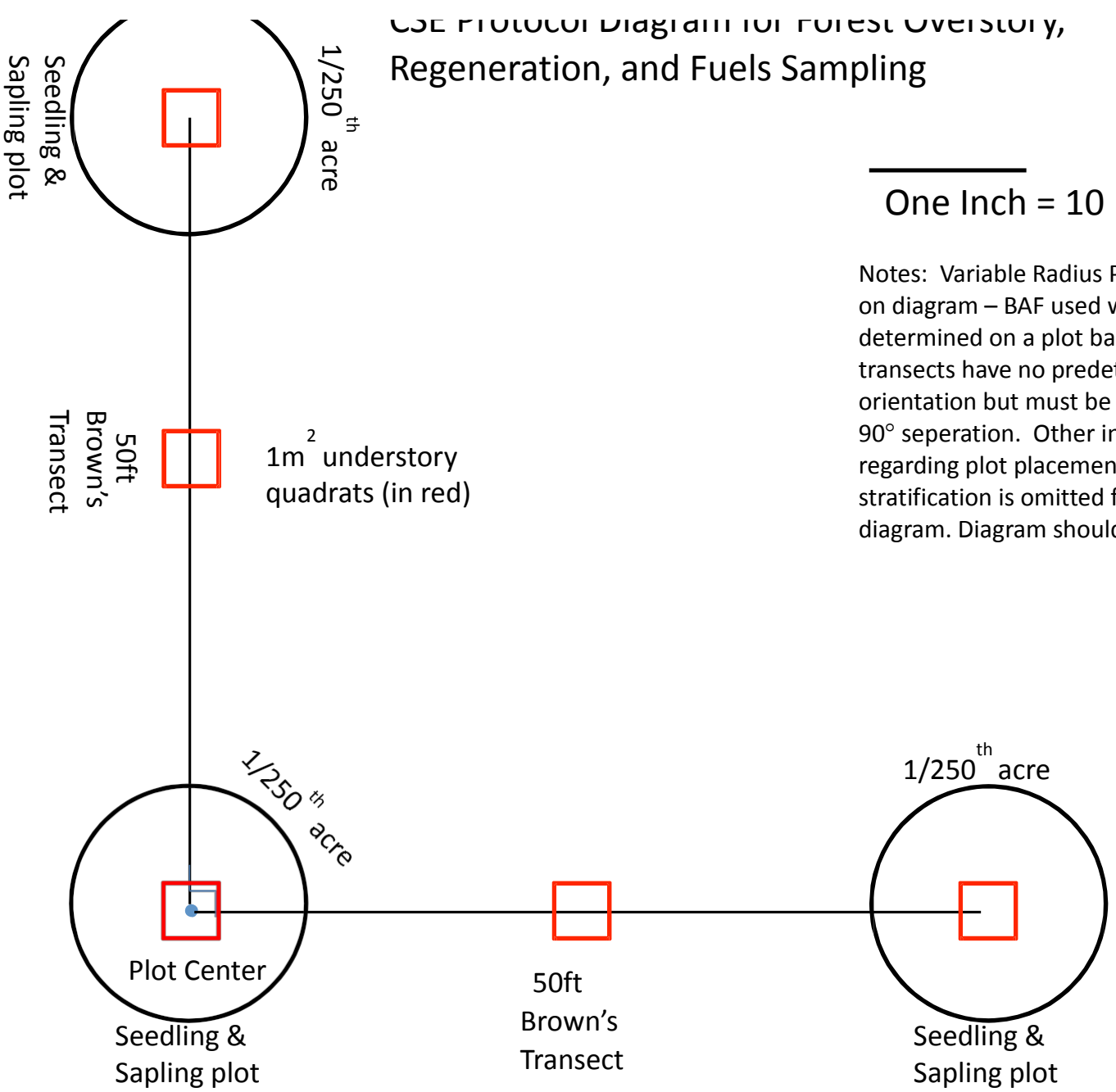
Table 6. Tier 1 Noxious and/or invasive understory species to monitor in lower montane forests.

Species	Noxious weed status
Bromus tectorum (cheatgrass)	Colorado List C noxious weed
Carduus nutans (musk thistle)	Colorado List B noxious weed
Centaurea diffusa (diffuse knapweed)	Colorado List B noxious weed
Centaurea maculosa (spotted knapweed)	Colorado List B noxious weed
Cirsium arvense (Canada thistle)	Colorado List B noxious weed
Euphorbia esula (leafy spurge)	Colorado List B noxious weed
Euphorbia myrsinites (Myrtle spurge)	Colorado List A noxious weed
Euphorbia cyparissias (cypress spurge)	Colorado List A noxious weed
Linaria dalmatica (dalmation toadflax)	Colorado List B noxious weed
Linaria vulgaris (butter-and-eggs)	Colorado List B noxious weed
Potentilla recta (sulfur cinquefoil)	Colorado List B noxious weed
Verbascum thapsus (Common mullein)	Colorado List C noxious weed

Table 7. Tier 1 native understory species to monitor in lower montane forests.

Species	Notes
Kinnikinnick (Arctostaphylos uva-ursi)	
Fringed sage (Artemisia frigida)	
White sagebrush (Artemisia ludoviciana)	
Blue grama (Bouteloua gracilis)	
Sedge (Carex spp.)	
Mountain mahogany (Cercocarpus montanus)	
Goosefoot (Chenopodium spp.)	
Hairy golden aster (Heterotheca villosa)	
Scarlet gilia (Ipomopsis aggregata)	
Common juniper (Juniperus communis)	
Spike fescue (Leucopoa kingii)	More common on the AR than the PSI
Dotted blazing star (Liatris punctata)	
Mountain muhly (Muhlenbergia montana)	
Ninebark (Physocarpus monogynus)	More common on the AR than the PSI
Antelope bitterbrush (Purshia tridentata)	More common on the AR than the PSI
Little bluestem (Schizacharium scoparium)	
Soapweed yucca (Yucca glauca)	

CSE Protocol Diagram for Forest Overstory, Regeneration, and Fuels Sampling



One Inch = 10 Feet

Notes: Variable Radius Plot not shown on diagram – BAF used will be variable determined on a plot basis. Brown's transects have no predetermined orientation but must be placed with a 90° seperation. Other information regarding plot placement and stratification is omitted from this diagram. Diagram should be to scale.