Monitoring Manual

for Grassland, Shrubland and Savanna Ecosystems

Volume II: Design, supplementary methods and interpretation

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Cover illustration:
Collecting Line-point intercept data
in a south-central New Mexico desert grassland.

Chapter 12

Tree density

It is important to quantify the density and size of trees in savannas and grazed woodlands in order to understand the structural diversity of the plant community. Structural diversity at a site can provide protection from elements and cover for wildlife. Increased density of trees in savannas and grazed woodlands could indicate a trend toward an important community change.

The method described here is extracted from the *USFS Forest Inventory and Analysis (FIA) National Core Field Guide Volume I: Field Data Collection Procedure for Phase 2 Plots,* Version 1.7 (USDA Forest Service 2003). The FIA protocol includes a large number of additional requirements (e.g., assigning a unique record number to each tree) and indicators not needed for our monitoring objectives. For more information on the FIA protocol, please see http://srs.fs.usda.gov/fia/manual/p2manual.htm.

Materials

- The same transect(s) used for Line-point and Gap intercept
- Extending range pole
- Steel pins for anchoring tape
- Additional tape (for defining subplots)
- Diameter or DBH tape
- Clipboard, Tree Density and Size Data Forms and pencil(s)

Standard methods (rule set)

1. Define measurement area for trees and saplings (>2.5 cm [1 in] in DBH [Diameter at Breast Height] or DRC [Diameter at Root Collar]).

Rules

1.1 Establish four subplots, one with its center located at the center of the spoke and the remaining three located at 36.6 m (120 ft) on each of the three transects (Fig. 12.1).

1.2 Subplots should have a 7.3 m (24 ft) radius (see subplots in Fig 12.1).

1.3 Other subplot sizes may also be used. If using a different subplot size be sure to record the size and adjust indicator calculations accordingly.

2. Determine for which species DRC will be used instead of DBH.

Rules

2.1 DRC is normally used on multi-stemmed species.

2.2 A list of species that the USFS classifies as multi-stemmed can be found in Appendix 4 of the FIA protocol (USDA Forest Service 2003).

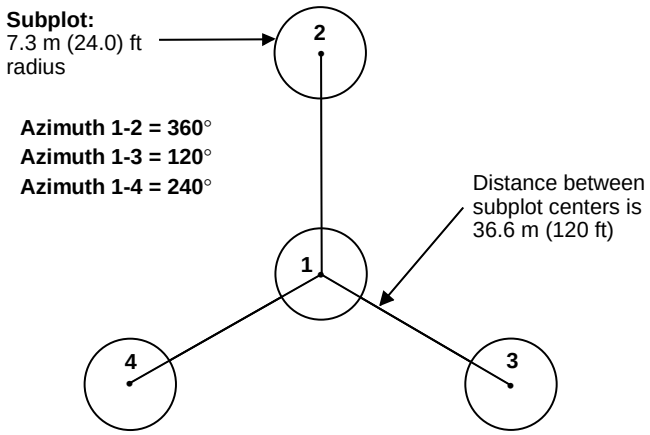

Figure 12.1. USFS Forest Inventory and Analysis plot diagram (modified from USDA Forest Service 2003).

3. Record the species or common name for each tree that falls within each subplot.

Rules

3.1 Include only those individuals with at least 50 percent of the plant base inside the plot.

3.2 Use the same codes or names used for the Line-point intercept method.

3.3 Record the species code in the "Species" column of the Tree Density and Size Data Form.

Figure 12.2. Savanna/woodland ecosystem showing relatively low tree density.

4. Record the DBH or DRC in the appropriate column.

Rules

4.1 Measure DBH at 1.4 m (4.5 ft) using a diameter tape (Fig. 12.3).

4.2 If a diameter tape is not available, measure with a standard tape measure and convert to diameter with the following formula ($\pi \approx 3.14$):

diameter = circumference $\div \pi$

4.3 Measure DRC as illustrated in Fig. 12.4. For multi-stemmed individuals,

DRC for the tree = SQRT (SUM [DRC^2]).

Figure 12.3. Measuring DBH.

5. Record each tree's height.

Rules

5.1 Measure the maximum height of the tree as the distance from the bottom of the trunk to the highest point of the canopy.

5.2 If the tree is too tall to measure with a meter/yard stick, use an extendable range pole (Fig. 12.5), visually estimate the height, or use a clinometer and trigonometry.

5.3. Record tree height in the "Height" column on the data form.

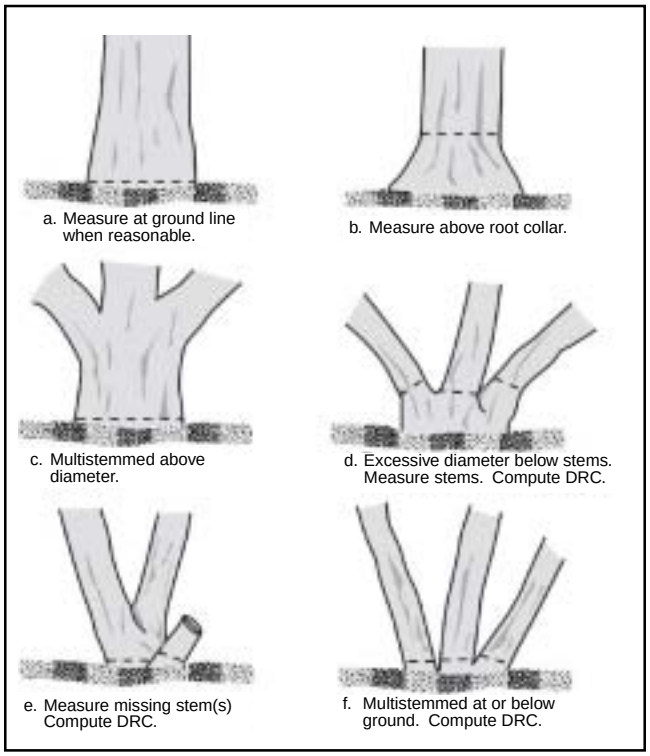

Figure 12.4. How to measure DRC (modified from USDA Forest Service 2003).

Figure 12.5. Measuring tree height with an extendable range pole.

Tree density calculations

1. Calculate the plot area in acres.

Rules

1.1 Plot area = (4 x π x plot radius x plot radius) ÷ conversion factor (π ≈3.14).

1.2 The metric conversion factor is 10,000 (converts square meters to hectares).

1.3 The English conversion factor is 107,639 (converts square feet to hectares).

2. Sum the number of trees and saplings.

Rules

2.1 Count all trees detected on all four subplots (trees have a DBH or DRC ⩾12.7 cm or 5 in).

2.2 Count all saplings detected on all four subplots (saplings have a DBH or DRC ⩾2.5 cm or 1 in and ⩽12.7 cm or 5 in).

3. Calculate densities.

Rules

3.1 Tree density = (total no. of trees) ÷ (plot area).

3.2 Sapling density = (total no. of saplings) ÷ (plot area).

Example

Tree Density and Size Data Form

Monitoring plot: 3 **Date:** 22 July 2003 **Line length:** 50 **(m or ft?)** circle one

Observer: Mark Second **Recorder:** Tara Third

Subplot radius 18 **(m or ft?)** circle one **Diameter units: (cm or in?)** circle one **Height units: (m or ft?)** circle one

Subplot 1 (plot center)				Subplot 2 (Line 1)				Subplot 3 (Line 2)				Subplot 4 (Line 3)			
Species	DBH	DRC	Ht.	Species	DBH	DRC	Ht.	Species	DBH	DRC	Ht.	Species	DBH	DRC	Ht.
POFR	40		6.5					POFR	52		11.5	POFR	4		3
												FRVE	35		10

Total plot area (all plots) = (4 x 3.14 x 18 m x 18 m) ÷ 10,000 = 0.41 hectares
(plot radius; plot radius)

Total plot area (all plots) = (4 x 3.14 x ____ ft x ____ ft) ÷ 107,639 = ____ hectares
(plot radius; plot radius)

3 = Total number of TREES (DBH ≥ 12.7 cm [5 in])

1 = Total number of SAPLINGS (2.5 cm [1 in] < DBH < 12.7 cm [5 in])

Tree density = No. of trees / Plot area = 3 / 0.41 = 7.32

Sapling density = No. of saplings / Plot area = 1 / 0.41 = 2.44

Tree Density and Size Data Form

Monitoring plot: _____ **Date:** _____ **Line length:** _____ **(m or ft?)** (circle one)

Observer: _____ **Recorder:** _____

Subplot radius _____ **(m or ft?)** (circle one) **Diameter units: (cm or in?)** (circle one) **Height units: (m or ft?)** (circle one)

Subplot 1 (plot center)				Subplot 2 (Line 1)				Subplot 3 (Line 2)				Subplot 4 (Line 3)			
Species	**DBH**	**DRC**	**Ht.**	**Species**	**DBH**	**DRC**	**Ht.**	**Species**	**DBH**	**DRC**	**Ht.**	**Species**	**DBH**	**DRC**	**Ht.**

Total plot area (all plots) = (4 x 3.14 x _____ (plot radius) m x _____ (plot radius) m) ÷ 10,000 = _____ hectares

Total plot area (all plots) = (4 x 3.14 x _____ (plot radius) ft x _____ (plot radius) ft) ÷ 107,639 = _____ hectares

_____ = Total number of TREES (DBH ≥ 12.7 cm [5 in])

_____ = Total number of SAPLINGS (2.5 cm [1 in] < DBH < 12.7 cm [5 in])

$$\text{Tree density} = \frac{\text{No. of trees}}{\text{Plot area}} = \frac{\quad}{\quad} = \quad \qquad \text{Sapling density} = \frac{\text{No. of saplings}}{\text{Plot area}} = \frac{\quad}{\quad} =$$