

# Monitoring Manual

for Grassland,  
Shrubland and  
Savanna Ecosystems

## Volume I: Quick Start

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Cover illustration:

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

### Line-point intercept

Line-point intercept is a rapid, accurate method for quantifying soil cover, including vegetation, litter, rocks and biotic crusts. These measurements are related to wind and water erosion, water infiltration and the ability of the site to resist and recover from degradation. For a detailed discussion of this and other methods for measuring plant cover and/or composition, see Elzinga et al. 2001<sup>2</sup>. For alternative Line-point intercept methods (including height measurements) see Volume II.

#### Materials

- Measuring tape (length of transect)—if using a tape measure in feet, use one marked in tenths of feet.
- Two steel pins for anchoring tape
- One pointer—a straight piece of wire or rod, such as a long pin flag, at least 75 cm (2.5 ft) long and less than 1 mm (1/25 in) in diameter
- Clipboard, Line-Point Intercept Data Form (page 12) and pencil(s)

#### Standard methods (rule set)

1. Pull out the tape and anchor each end with a steel pin (Fig. 6).

##### Rules

- 1.1 Line should be taut.
  - 1.2 Line should be as close to the ground as possible (thread under shrubs using a steel pin as a needle).
2. Begin at the “0” end of the line.
  3. Working from left to right, move to the first point on the line. Always stand on the same side of the line.



**Figure 6.** Transect line pulled taut.

4. Drop a pin flag to the ground from a standard height (\_\_\_ cm (\_\_\_ in)) next to the tape (Fig. 7).

##### Rules

- 4.1 The pin should be vertical.
- 4.2 The pin should be dropped from the same height each time. A low drop height minimizes “bounces” off of vegetation but increases the possibility for bias.
- 4.3 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.

#### Step-point or pace transect with pin (Semiquantitative alternative)

Use a pin flag dropped in front of your boot instead of the points on the tape.

##### Limitations:

Less accurate because it is difficult to walk a straight line, especially through shrubs. Using the toe of a boot instead of a pin creates additional errors because the boot often pushes plant canopies into interspaces. This leads to overestimates of plant canopy cover.

<sup>2</sup>Elzinga, C.L., D.W. Salzer, J.W. Willoughby and J.P. Gibbs. 2001. *Monitoring Plant and Animal Populations*, Blackwell Publishing. 368 pp.

## Long-Term Methods: Line-point intercept

- 4.4 A pair of lasers with a bubble level can be used instead of the pin. This tool is useful in savannas where canopy layers may be above eye level. See Appendix A (Monitoring tools) in Volume II for suppliers.

**5. Once the pin flag is flush with the ground, record every plant species it intercepts.**

**Rules**

- 5.1 Record the species of the first stem, leaf or plant base intercepted in the “Top canopy” column using the PLANTS database species code (<http://plants.usda.gov/>), a four-letter code based on the first two letters of the genus and species, or the common name.
- 5.2 If no leaf, stem or plant base is intercepted, record “NONE” in the “Top canopy” column.
- 5.3 Record all additional species intercepted by the pin.
- 5.4 Record herbaceous litter as “L,” if present. Litter is defined as detached dead stems and leaves that are part of a layer that comes in contact with the ground. Record “W” for detached woody litter that is greater than 5 mm (or ~1/4 in) in diameter and in direct contact with soil.
- 5.5 Record each canopy species only once, even if it is intercepted several times.
- 5.6 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 genus portion of the code and the functional group at the bottom of the data form (*Artemisia* species = AR01).
- 5.7 If you *cannot* identify the genus, use the following codes:
- AF#** = Annual forb (also includes biennials)
- PF#** = Perennial forb
- AG#** = Annual graminoid
- PG#** = Perennial graminoid
- SH#** = Shrub
- TR#** = Tree
- If necessary, collect a sample of the unknown off the transect for later identification.



**Figure 7.** Point falling on bare soil (NONE/S).

- 5.8 Canopy can be live or dead, but only record each species once. Be sure to record all species intercepted.

**6. Record whether the pin flag intercepts a plant base (Fig. 8) 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
- 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

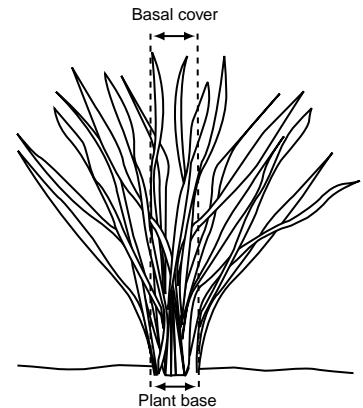
**Rules**

- 6.1 For unidentified plant bases, use the codes listed under 5.7.
- 6.2 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).
- 6.3 Additional categories may be added, such as “CYN” = dark cyanobacterial crust.

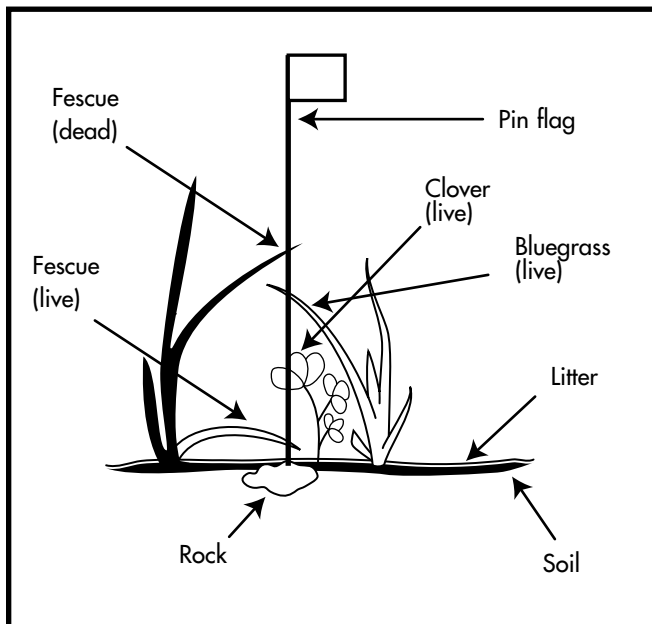
## Long-Term Methods: Line-point intercept

**Table 2.** Sample data form for examples illustrated below. Points 1 and 2 show the first two points on a line. In Point 1, the pin flag is touching dead fescue, live bluegrass, clover, live fescue, litter and a rock. Record fescue only once, even though it intercepts the pin twice. In Point 2, the flag touches fescue, then touches litter and finally the fescue plant base. Table 2 shows how to record these two points on the data form.

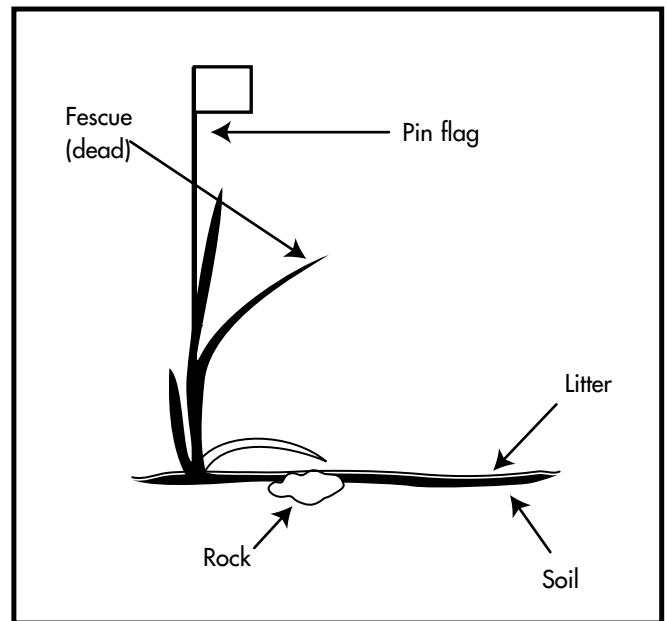
Pt.	Top canopy	Lower canopy layers			Soil surface
		Code 1	Code 2	Code 3	
1	Fescue	Bluegrass	Clover	L	R
2	Fescue	L			Fescue
3	Fescue	L			S
etc.					



**Figure 8.** Area defined as plant base and included as basal cover.



**Point 1**



**Point 2**

**Riparian note:** Line-point intercept collected perpendicular to the channel is often used to monitor riparian zone width. A modified point intercept method is used to monitor “greenline” vegetation along the channel’s edge (Vol. II, Chapter 13).

# Line-point Intercept Data Form

Page \_\_\_\_\_ of \_\_\_\_\_

Shaded cells for calculations

Plot: \_\_\_\_\_ Line #: \_\_\_\_\_ Observer: \_\_\_\_\_ Recorder: \_\_\_\_\_

Direction: \_\_\_\_\_ Date: \_\_\_\_\_ Intercept (Point) Spacing Interval = \_\_\_\_\_ cm ( \_\_\_\_\_ in)

Pt.	Top canopy	Lower canopy layers			Soil surface	Pt.	Top canopy	Lower canopy layers			Soil surface
		Code 1	Code 2	Code 3				Code 1	Code 2	Code 3	
1						26					
2						27					
3						28					
4						29					
5						30					
6						31					
7						32					
8						33					
9						34					
10						35					
11						36					
12						37					
13						38					
14						39					
15						40					
16						41					
17						42					
18						43					
19						44					
20						45					
21						46					
22						47					
23						48					
24						49					
25						50					

% canopy (foliar) cover = \_\_\_\_\_ canopy pts (1st col) x 2 = \_\_\_\_\_ %

% bare ground\* = \_\_\_\_\_ pts (w/NONE over S) x 2 = \_\_\_\_\_ %

% basal cover = \_\_\_\_\_ plant base pts (last col) x 2 = \_\_\_\_\_ %

**Top canopy codes:** Species code, common name, or NONE (no canopy).

**Lower canopy layers codes:** Species code, common name, L (herbaceous litter), W (woody litter, >5 mm (~1/4 in) diameter).

## Unknown Species Codes:

AF# = annual forb  
 PF# = perennial forb  
 AG# = annual  
       graminoid  
 PG# = perennial  
       graminoid  
 SH# = shrub  
 TR# = tree

## Soil Surface (do not use litter):

Species Code (for basal intercept)  
 R = rock fragment (>5 mm (~1/4 in) diameter)  
 BR = bedrock, M = moss  
 LC = visible lichen crust on soil  
 S = soil without any other soil surface code  
 EL = embedded litter (see page 10)  
 D = duff

\*Bare ground occurs ONLY when Top canopy = NONE, Lower canopy layers are empty (no L), and Soil surface = S.

# Line-point intercept indicator calculations

Canopy cover (as calculated here) does not include bare spaces within a plant's canopy.

### 1. Percent canopy (foliar) cover

#### Rules

- 1.1 Count the total number of canopy intercepts in the "Top canopy" column and record this number in the blank provided.
- 1.2 Canopy intercepts include all points where a plant is recorded in the "Top canopy" column. Do not include points that have a "NONE" in the "Top canopy" column.
- 1.3 Multiply the number of canopy intercepts (from 1.1) by 2\* and record your "% canopy cover" in the blank provided.

### 2. Percent bare ground

#### Rules

- 2.1 Count the total number of points along the line that have bare ground and record this number in the blank provided.
- 2.2 Bare ground occurs **only** when:
  - A. There are no canopy intercepts

(NONE is recorded in the "Top canopy" column).

- B. There are no litter intercepts ("Lower canopy layers" columns are empty).
- C. The pin only intercepts bare soil ("S" recorded in the "Soil surface" column).

- 2.3 Multiply the number of bare ground hits (from 2.1) by 2\* and record your "% bare ground" in the blank provided.

### 3. Percent basal cover

#### Rules

- 3.1 Count the total number of plant basal intercepts in the "Soil surface" column and record this number in the blank provided.
- 3.2 Plant basal intercepts occur anytime the pin intercepts a live or dead plant base (Species code recorded in "Soil surface" column).
- 3.3 Multiply the number of basal intercepts (from 3.1) by 2\* and record your "% basal cover" in the blank provided.

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\*For 50 points per line. Multiply by 1 for 100 points per line. Multiply by 4 for 25 points per line.

**Table 3.** Line-point intercept data form example showing a 50-point line and associated indicator calculations.

Page 1 of 1

Shaded cells for calculations

Plot: 3 Line #: 2 Observer: Jane Smith Recorder: David Patrick

Direction: 120° Date: 10/15/2002 Intercept (Point) Spacing Interval = 100 cm (    in)

Pt.	Top canopy	Lower canopy layers			Soil surface	Pt.	Top canopy	Lower canopy layers			Soil surface
		Code 1	Code 2	Code 3				Code 1	Code 2	Code 3	
1	BOER				BOER	26	PRGL	BOER			S
2	BOER				S	27	NONE	L			S
3	SPO1	BOER			S	28	BOER				LC
4	BOER				S	29	SPO1	BOER			S
5	NONE				S	30	YUEL	L			S
6	BOER				S	31	BOER				S
7	NONE	L			S	32	NONE				R
8	NONE				S	33	BOER				S
9	BOER				S	34	NONE	L			S
10	BOER	L			S	35	BOER				S
11	BOER	L			S	36	BOER	L			BOER
12	BOER				S	37	BOER	L			S
13	NONE				S	38	BOER	L			S
14	BOER				S	39	NONE				S
15	NONE	L			S	40	NONE	L			S
16	NONE				R	41	BOER				S
17	BOER				S	42	PRGL	SPO1			S
18	BOER				BOER	43	PRGL				S
19	NONE				R	44	SPO1				S
20	BOER				S	45	NONE				S
21	BOER				S	46	BOER				S
22	SPO1				S	47	BOER				BOER
23	BOER	L			S	48	BOER	L			S
24	NONE	L			S	49	NONE	L			S
25	NONE	L			S	50	BOER	GUSA			S

% canopy (foliar) cover = 34 canopy pts (1st col) x 2 = 68 %

% bare ground\* = 5 pts (w/NONE over S) x 2 = 10 %

% basal cover = 4 plant base pts (last col) x 2 = 8 %

**Top canopy codes:** Species code, common name, or NONE (no canopy).

**Lower canopy layers codes:** Species code, common name, L (herbaceous litter), W (woody litter, >5 mm (~1/4 in) diameter).

#### Unknown Species Codes:

AF# = annual forb  
PF# = perennial forb  
AG# = annual graminoid  
PG# = perennial graminoid  
SH# = shrub  
TR# = tree

#### Soil Surface (do not use litter):

Species Code (for basal intercept)  
R = rock fragment (>5 mm (~1/4 in) diameter)  
BR = bedrock, M = moss  
LC = visible lichen crust on soil  
S = soil without any other soil surface code  
EL = embedded litter (see page 10)  
D = duff

\*Bare ground occurs ONLY when Top canopy = NONE, Lower canopy layers are empty (no L), and Soil surface = S.

### Line-point intercept basic interpretation

Increases in **canopy cover** are correlated with increased resistance to degradation. **Basal cover** is a more reliable long-term indicator. Basal cover is less sensitive to seasonal and annual differences in precipitation and use. Increases in **bare ground** nearly always indicate a higher risk of runoff and erosion.

Where species composition changes may be occurring, calculate basal and canopy cover for each major species. Canopy cover usually is used for shrubs, trees and sometimes grasses. Basal cover is used for perennial grasses. When calculating single species canopy cover, be sure to include each time the species is intercepted, regardless of whether it is in the top or lower canopy layer.

Use these indicators together with the indicators from the **Gap intercept** and the **Soil stability test** to help determine whether observed erosion changes are due to loss of cover, changes in the vegetation's spatial distribution, or reduced soil sta-

bility. Use these indicators together with the **Belt transect** to track changes in species composition. For more information about how to interpret these indicators, please see Chapter 17 in Volume II.

Typical effect on each attribute of an increase in the indicator value			
Indicator	Soil and site stability	Hydrologic function	Biotic integrity
Canopy cover (%)	+	+	+
Bare ground (%)	—	—	—
Basal cover (%)	+	+	+