

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.

Gap intercept

Gap intercept measurements provide information about the proportion of the line covered by large gaps between plants. Large gaps between plant canopies are important indicators of potential wind erosion and weed invasion. Large gaps between plant bases are important indicators of runoff and water erosion.

Materials.

- Measuring tape (at least as long as transect)—if tape is in feet, use one marked in tenths of feet.
- Two steel pins for anchoring tape
- Meter stick or other stiff stick
- Clipboard, Gap Intercept Data Form (page 20) and pencil(s)

Standard methods (rule set)

Steps 1-4 for both canopy and basal gap intercept.

1. Pull out the tape and anchor each end with steel pin.

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. Work from left to right, move to the first point on the line. Always stand on the same side of the line.

Rules

- 3.1 Look straight down on the tape. Use a meter stick or other stiff stick to project a line vertically to the ground.
- 3.2 Assume that there is a wall at each end of the tape. Do not consider gaps or vegetation that occur off the end of the tape.

4. Record whether or not annuals are included.

Rules

- 4.1 The standard method is to include annual grasses and ignore annual forbs due to the



Figure 9. A canopy gap.

highly variable and ephemeral nature of forb production in most arid and semiarid ecosystems.

- 4.2 Annuals may be ignored in ecosystems where they have little effect on reducing wind and water erosion and/or where their occurrence is extremely variable among years.
- 4.3 Apply the same method each year.

Final step for canopy gap intercept

5. Record the beginning and end of each gap between plant canopies longer than 20 cm (0.7 ft).

Rules

- 5.1 Canopy occurs any time 50% of any 3 cm (0.1 ft) segment of tape edge intercepts live or dead plant canopy based on a vertical projection from canopy to ground. Always read on the graduated side of the tape.
- 5.2 The minimum gap size can be increased or decreased as appropriate for the site. For example, where wind erosion is important, the minimum gap size can be increased for plant communities with tall vegetation. Once monitoring has begun, the minimum gap size can only be increased. Be sure to record the minimum gap size on the data form.

- 5.3 A plant canopy can stop a gap whether live or dead.
- 5.4 Record the start and end of a gap to the nearest centimeter (or 0.1 ft).

Final step for basal gap intercept

6. Record the beginning and end of each gap between plant bases longer than 20 cm (0.7 ft).

Rules

- 6.1 A plant base is any plant stem emerging from the soil surface along the graduated edge of the tape that would force an ant walking along the line on the soil to step off the line to get around it (minimum diameter = 1 mm or 1/25 of an in).
- 6.2 A basal gap occurs any time there is at least 20 cm (0.7 ft) of intercept without a plant base. Therefore, there should always be at least 20 cm (0.7 ft) between basal gap starts and basal gap ends.
- 6.3 A plant base can stop a gap whether live or dead.
- 6.4 Plant bases may be live or dead, but they must be anchored in the ground. Litter is not a plant base. Where litter is an important obstruction to runoff, the rules can be changed to include it. Be sure to record this change on the data form and in your rule set.
- 6.5 Record the start and end of a gap to the nearest centimeter (or 0.1 ft).

Step gap (Semiquantitative alternative)

Walk 50 paces in each direction (e.g., 0°, 120°, 240°) and record the number of times your boot lands completely within a vegetation gap. In other words, the gap is the size of your boot or larger. Another variation is to record the number of gaps larger than a particular size that your toe lands in.

$$\text{Indicator} = 100 \times \frac{\text{No. of gaps}}{\text{Total No. acres}}$$

Long-Term Methods: Gap intercept

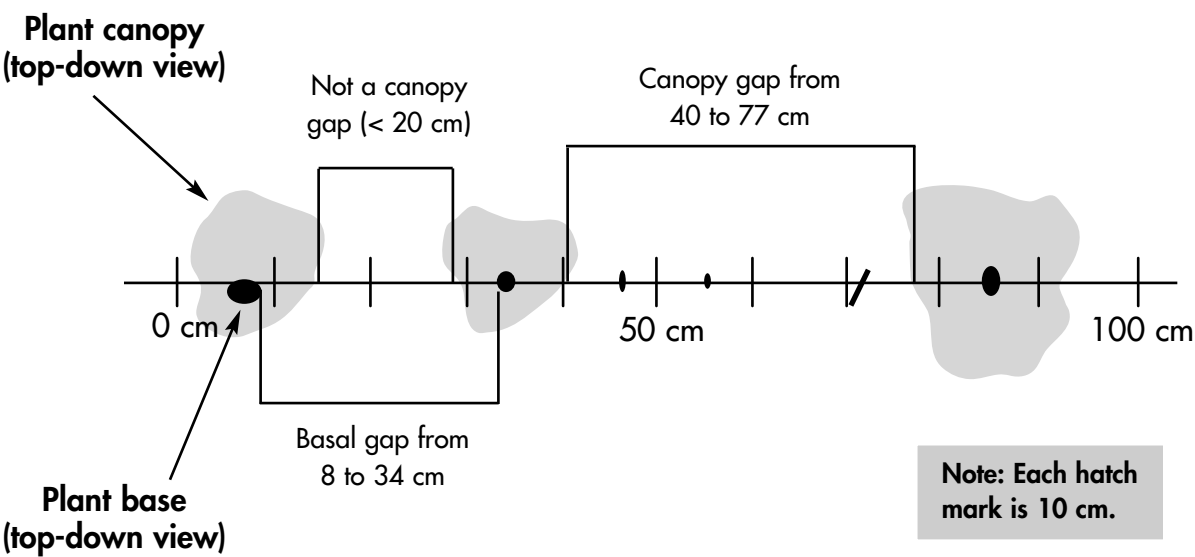


Figure 10. Example of canopy gap intercepts (above the line) and basal gap intercepts (below the line) for 1 m (100 cm) of a 50 m line. Canopy gaps: There is a gap between 40 and 77 cm because the plant canopies present do not cover more than 50% of any 3 cm segment. Basal gaps: There is a basal gap between 8 and 34 cm. Because the three small plant bases between 34 cm and 86 cm are all within 20 cm of an adjacent plant base, there are no basal gaps even though there is a canopy gap.

Table 4. Gap intercept data form example associated with Figure 10.

Canopy gaps: Minimum size = 20 cm							Basal gaps: Minimum size = 20 cm						
Starts	Ends	Gap size	25-50	51-100	101-200	>200	Starts	Ends	Gap size	25-50	51-100	101-200	>200
40	77	37	37				8	34	26	26			

When using feet instead of meters, use the decimal (1/10) side of the tape. Most long tape measures include inches on one side and 1/10s of feet on the other. This makes calculations much easier.

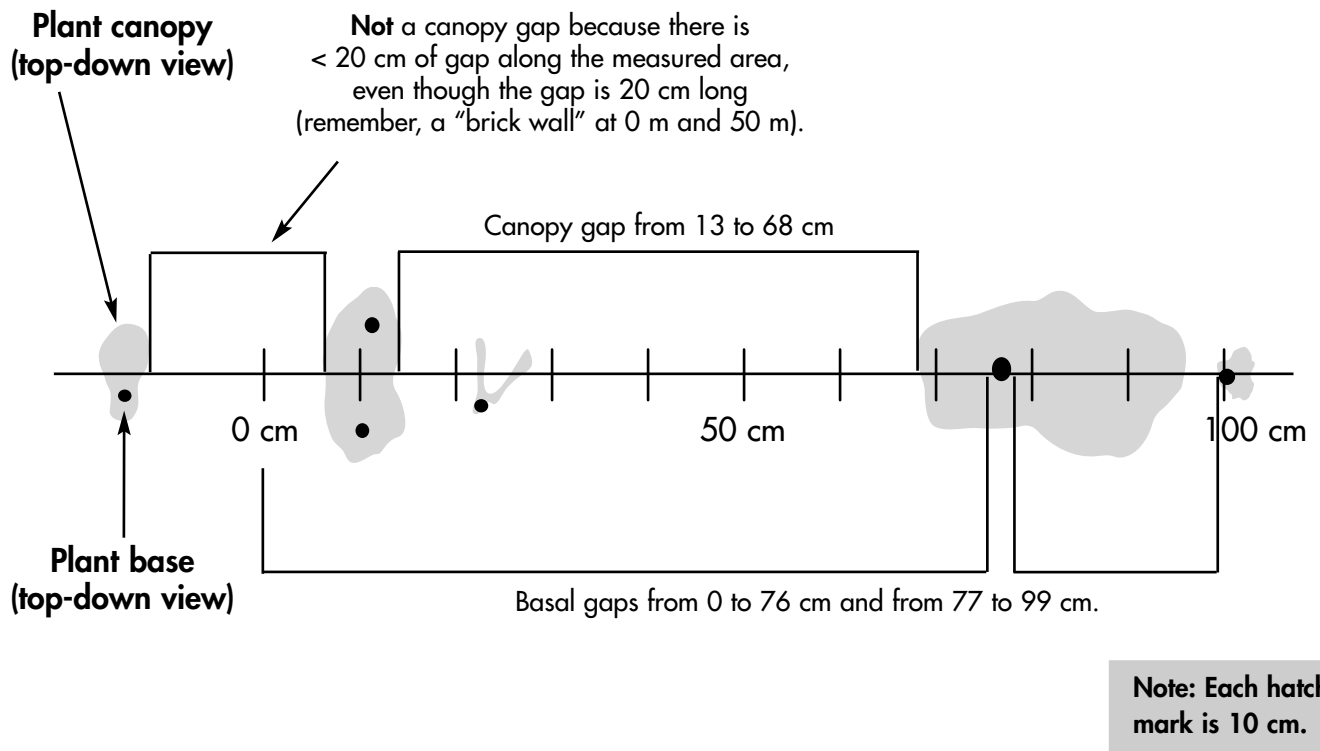


Figure 11. Example of canopy gap intercepts (above the line) and basal gap intercepts (below the line) for 1 m (100 cm) of a 50 m line. Canopy gaps: Look at the plant canopy intercept between the 20 and 30 cm marks on the transect. Because each canopy intercept covers less than 50 percent of a 3 cm segment of the line, it does not count as canopy.

Table 5. Gap intercept data form example associated with Figure 11.

Canopy gaps: Minimum size = <u>20</u> cm							Basal gaps: Minimum size = <u>20</u> cm						
Starts	Ends	Gap size	25-50	51-100	101-200	>200	Starts	Ends	Gap size	25-50	51-100	101-200	>200
13	68	55		55			0	76	76		76		
							77	99	22				

Riparian note: No changes are needed for this method in riparian areas.

Gap Intercept Data Form

Monitoring plot: _____ Line: _____ Date: _____ Shaded cells for calculations
 Reader: _____ Recorder: _____ Line Length _____ m or ft Page _____ of _____

[illegible]

Example: If SUM 25-50 = 1,573, Line Length = 5,000 cm, then % of line in gaps 25-50 cm = $100 \times (\text{SUM 25-50}/\text{line length}) = 100 \times (1,573/5,000) = 31.5\%$.

Gap intercept indicator calculations

1. Canopy gaps: Calculate the percentage of the line covered in gaps 25-50 cm, 51-100 cm, 101-200 cm and greater than 200 cm long.

Rules

- 1.1 Calculate each **Gap size** in centimeters (**Gap ends – Gap starts**) for each canopy gap entered on the data sheet.
- 1.2 If a gap is 25-50 cm long, record its “Gap size” (cm) under the “25-50” column. Repeat this for the remaining columns (51-100, 101-200 and >200) and for all gaps.
- 1.3 Add the gaps up for each shaded column and record this value next to “SUM” on the data form. This is the total amount of the line (in centimeters) covered by gaps 25-50, 51-100, 101-200, >200 cm.
- 1.4 Record the “LINE LENGTH” in centimeters on the data form. Line length is equal to

the length of the line (in meters) multiplied by 100.

- 1.5 Starting with the gaps 25-50 cm, divide the “SUM” by the “LINE LENGTH” and multiply this value by 100 to obtain the percent of the line covered in gaps 25-50 cm. Record this value under the appropriate column next to “% of line in gaps”. Repeat this for gaps 51-100, 101-200, and >200 cm.

2. Basal gaps: Calculate the percentage of the line covered in gaps 25-50 cm, 51-100 cm, 101-200 cm and greater than 200 cm long.

Rules

- 2.1 Follow steps 1.1 through 1.5 above for basal gaps.
3. Optional for canopy and basal gaps: Use a different color or pattern to mark a slice of the pie chart for each gap’s size class. The dark green section represents the area covered by plants and gaps less than 25 cm (Fig. 12).

Table 6. Gap intercept data form example showing part of a 50-m line and associated indicator calculations.

Canopy gaps: Minimum size = <u>20</u> cm (<u> </u> ft)							Basal gaps: Minimum size = <u>20</u> cm (<u> </u> ft)						
Starts	Ends	Gap size	25-50	51-100	101-200	>200	Starts	Ends	Gap size	25-50	51-100	101-200	>200
40	60	20					27	64	37	37			
101	202	101			101		70	264	194			194	
237	963	726				726	269	459	190			190	
:	:	:	:	:	:	:	:	:	:	:	:	:	:
4704	4754	50	50				3560	4784	1224				1224
4761	4925	164			164		4720	4813	93		93		
4931	5000	69		69			4817	5000	183			183	
SUM (cm)			50	69	265	726	SUM (cm)			37	93	567	1224
LINE LENGTH (cm)			5000	5000	5000	5000	LINE LENGTH (cm)			5000	5000	5000	5000
% of line in gaps			1%	1.4%	5.3%	14.5%	% of line in gaps			0.7%	1.9%	11.3%	24.5%

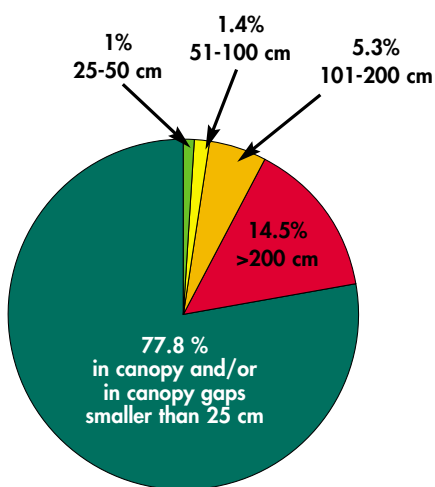
$$\begin{array}{ccccccc}
 \nearrow & \nearrow & \nearrow & \nearrow & \nearrow & \nearrow & \nearrow \\
 100 \times (50/5000) & 100 \times (69/5000) & 100 \times (265/5000) & 100 \times (726/5000) & 100 \times (37/5000) & 100 \times (93/5000) & 100 \times (567/5000) \\
 & & & & & & 100 \times (1224/5000)
 \end{array}$$

Gap intercept basic interpretation

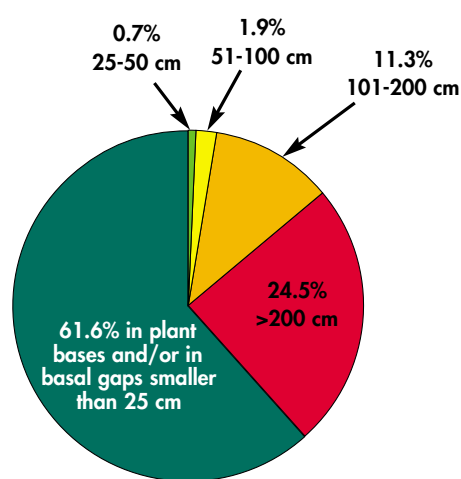
Increases in the proportion of the line covered by **canopy gaps** are related to increased risk of wind erosion and invasive “weed” species establishment. For example, wind velocities in most areas of the western United States are capable of moving disturbed soil in 50-cm (20-in) gaps in grasslands. Disturbed soil in gaps 1-2 m (3-6 ft) in diameter is nearly as susceptible to erosion as that with no vegetation. Minimum gap size required to cause wind erosion increases with vegetation height. Increases in the proportion of the line covered by large **basal gaps** reflect increased susceptibility to water erosion and runoff. Plant bases slow water movement down slopes. As basal gaps increase, there are fewer obstacles to water flow, so runoff and erosion increase. Increases in large basal gaps have a greater effect where rock and litter cover are low, because they are the only obstacles to water flow and erosion.

Use these indicators together with the cover indicators from the **Line-point intercept** and the **Soil stability test** to help determine whether observed erosion changes are due to loss of cover, changes in spatial distribution of vegetation or reduced soil stability. Where the gaps are approximately circular, the typical gap diameter is approximately 1.3 times the gap intercept. For more information about how to interpret these indicators, please see Volume II, Chapter 17.

Typical effect on each attribute of an increase in the indicator value			
Indicator	Soil and site stability	Hydrologic function	Biotic integrity
Canopy gaps (%)	–	–	–
Basal gaps (%)	–	–	–



Canopy Gap Pie Chart



Basal Gap Pie Chart

Figure 12. Examples of how to present gap intercept data in pie charts. Size of each pie slice is proportional to the area covered by each type of gap.