Variable Point Sampling

Point sampling or variable plot sampling is based on the idea that every tree size has a different size plot all centered on a point. The plot extent is usually measured with a angle gauge. The angle gauge can be mechanical (e.g., angle spanning gauges), optical (e.g., prisms), or a combination (e.g., relaskop).

The following figure illustrates how a prism is used on level ground to determine if a tree is in or out of the plot. Border trees can greatly influence the statistics collected from the sample so it is recommended to measure all border trees and compare against a limiting distance table.
This table can be calculated using the formula for plot radius below and a spreadsheet. Limiting distances are measured from plot center to the center of the tree.

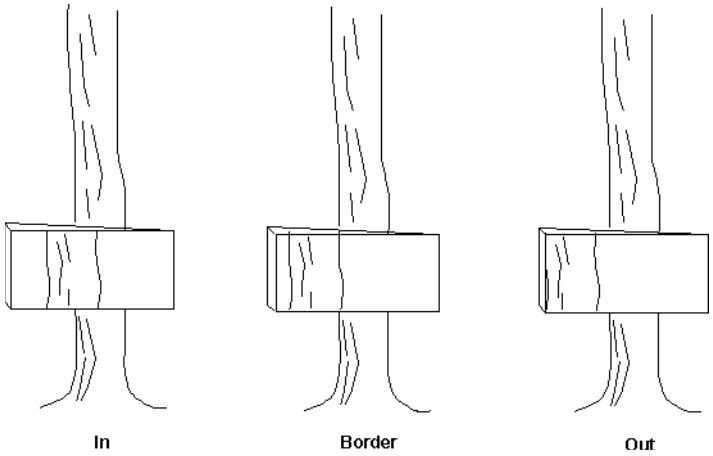

Figure 1. Illustration of the view through a glass prism.

The following diagram illustrates what the prism is doing and how the image is displaced by the prism. Please note that the apexes of different angle gauges are different. The apex should be held over plot center. With optical gauges the apex is the device it self. With mechanical gauges, it is your eye.

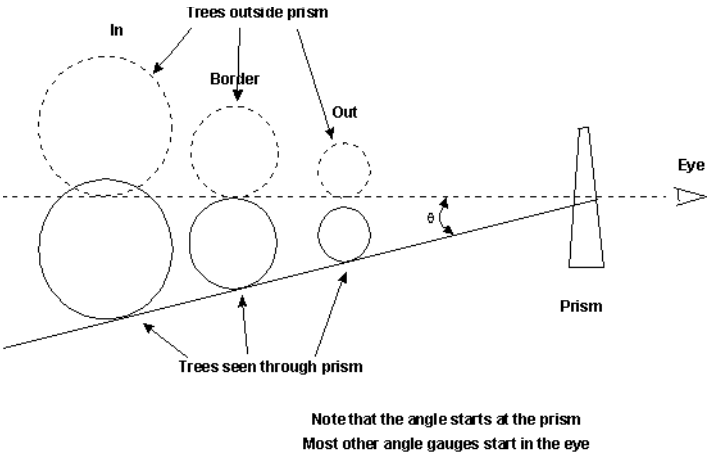

Figure 2. Description of the geometry of the prism optical displacement.

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If using an angle gauge on a slope you must correct for the slope in the direction you are looking. That means up and down slope you correct, looking side slope you do not correct. The way to slope correct with a prism is by turning the prism at an angle parallel to the slope along which you are looking. Again, when in doubt, measure the distance to the tree and compare to a table of limiting distances.

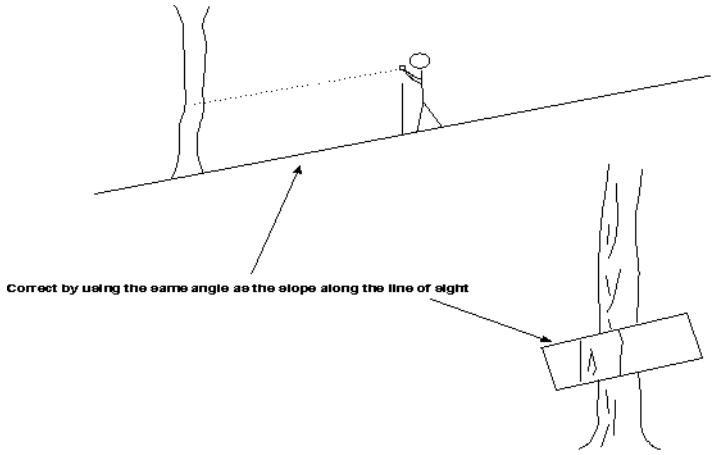

Figure 3. Illustration of how to slope correct when using a prism

Formulas in English units

The following formulas are most of the formulas needed when doing normal horizontal point sampling. A more complete set is available in Husch (2003).

Variable	English Formula
Gauge angle	$k = \frac{D}{12R} = 2 \cdot \sin\frac{\theta}{2}$
Plot radius	$R = \frac{D}{12k} = \frac{33\sqrt{10} \cdot D}{12\sqrt{F}}$
Plot area	$A = \pi R^2 = \pi\left(\frac{D}{12k}\right)^2$
Trees per acre	$TPA = \frac{43560}{A} = \frac{10{,}890k^2}{0.005454D^2} = \frac{F}{BA} = \frac{E}{D^2}$
Basal Area Factor	$F = BA(TPA) = 10{,}890k^2$
Expansion constant	$E = \frac{F}{0.005454}$

Source: Husch et al. 2003.

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Formulas in metric units

These are the same formulas only the constants have been change for use with metric units.

Variable	Metric Formula
Gauge angle	$k = \frac{D}{100k} = 2 \cdot \sin\frac{\theta}{2}$
Plot radius	$R = \frac{D}{100k} = \frac{D}{2\sqrt{F}}$
Plot area	$A = \pi R^2 = \pi\left(\frac{D}{100k}\right)^2$
Trees per acre	$TPA = \frac{10000}{A} = \frac{2{,}500k^2}{0.00007854D^2} = \frac{F}{BA} = \frac{E}{D^2}$
Basal Area Factor	$F = BA(TPA) = 2500k^2$
Expansion constant	$E = \frac{F}{0.00007854}$

Source: Husch et al. 2003.

Husch, B., T. W. Beers, and J. A. Kershaw, Jr. 2003. Forest Mensuration. John Wiley and Sons, Inc. Hoboken, New Jersey. 443 pp. ISBN 0-471-01850-3

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