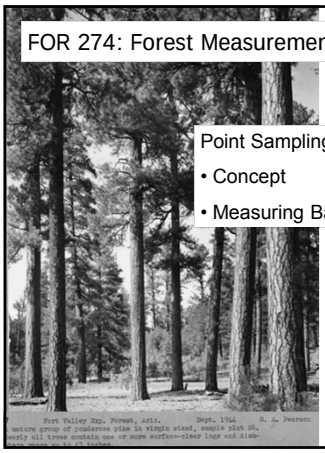
FOR 274: Forest Measurements and Inventory

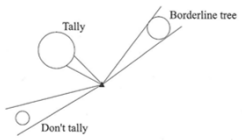


Point Sampling Inventories

- Concept
- Measuring Basal Area

Point Sampling Inventories: Concept

In point inventories, trees are sampled based on their size and not by how often they occur.



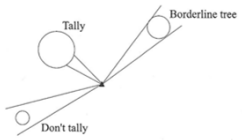
Points are located as part of a cruise and a fixed angle tool is used to look at the tree's DBH to determine whether a tree is in or out of the plot.

Notes:
- The smaller the angle, more stems will be included
- Larger trees are more likely to be included in the cruise
- No need to set up plot corners: fast cruising method

Point Sampling Inventories: Concept

In fixed area plots it was easy to scale the plot measure to an acre measure i.e. multiply the values by the reciprocal of the plot size:

e.g., For 10^{th} acre plot: trees in plot x 10 = trees per acre

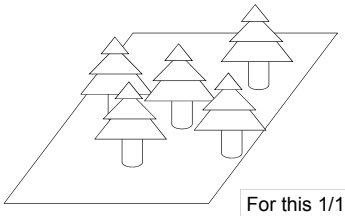


In point sampling, this multiplication factor is dependent on the size of the trees being sampled.

This multiplication (or expansion factor) is called the Basal Area Factor (BAF), where # of trees X BAF = BA per acre.

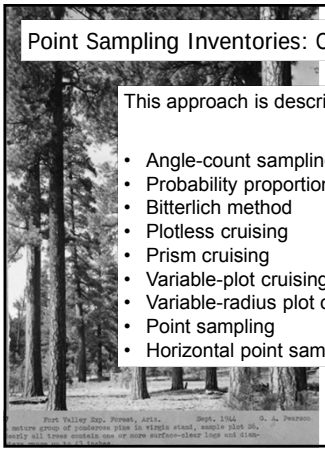
Point Sampling Inventories: Concept

Therefore, each tree selected for measurement represents *TF* trees per units area: hence “Tree Factor”



For this 1/10th acre square plot each measured tree “represents” 10 trees per acre.

Point Sampling Inventories: Concept



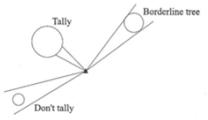
This approach is described by lots of names:

- Angle-count sampling
- Probability proportional to size (PPS)
- Bitterlich method
- Plotless cruising
- Prism cruising
- Variable-plot cruising
- Variable-radius plot cruising
- Point sampling
- Horizontal point sampling

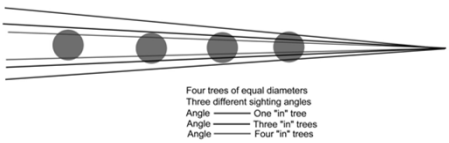
Point Sampling Inventories: Application

Step 1. Select an angle

The selection of the angle is based on experience of the tree sizes and distribution in the stand, but the aim is such that ideally 5-12 trees will be tallied at each point.

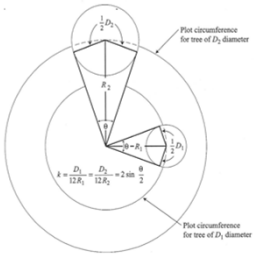


Examples of what you may use:
BAF 5: low density pole stands
BAF 10: high density pole stands
BAF 20: large, old growth saw timber
BAF 40: pacific Douglas fir



Point Sampling Inventories: Application

Plot radius is proportional to tree diameter: For trees right at edge the diameter / plot radius = a constant, k



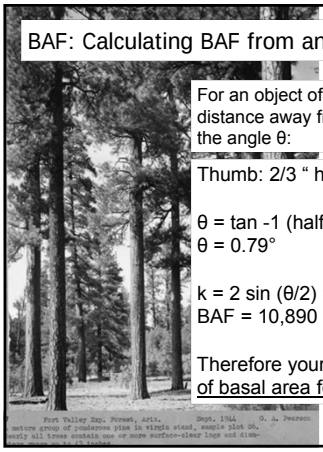
From some math:

BAF = 10890*(D^2/R^2)

And from some trig:

D/R = 2 sin (θ/2)

BAF: Calculating BAF from an angle



For an object of fixed width, held a fixed distance away from your eye you can work out the angle θ:

Thumb: 2/3 " held at 24" away

θ = tan -1 (half width / distance) = 0.3333/24
θ = 0.79°

k = 2 sin (θ/2) = 0.014
BAF = 10,890 k^2 = 2.13

Therefore your thumb "represents 2.13 units of basal area for each tree measured"

Point Sampling Inventories: Application

Step 2. Plot Radius Factor

To calculate whether a tree will be IN we think about the D/R ratio as a triangle.

R = Distance from tree to point

BAF (ft^2/acre)	Angle size (mm)	Angle size (diopters)	Ratio (DBH/plot radius)	Plot Radius Factor (PRF)
5	73.66	2.14	1/46.7	3.889
10	104.18	3.03	1/33.0	2.750
15	127.59	3.71	1/26.9	2.245
80	295.25	7.44	1/13.5	1.125

A 1" DBH tree measured with a 10 BAF will be IN if its within 33 inches of the point.

A 12" DBH tree measured with a 10 BAF will be IN if its within (12*33) = 396" = 33 ft of the point.

Point Sampling Inventories: Application

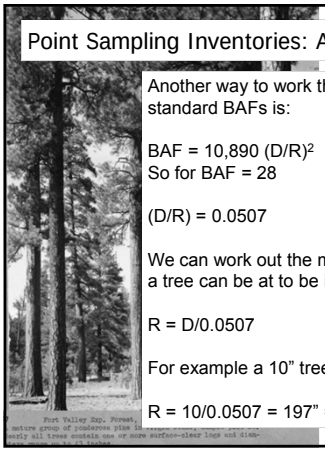
Step 2. Plot Radius Factor

The Plot Radius Factor (PRF) allows us to calculate for a given BAF the maximum distance (or limiting distance) that a tree can be from the point to be IN.

DBH (inches) x PRF = Maximum Distance from Point (feet)

BAF (ft^2/acre)	Angle size (mm)	Angle size (diopters)	Ratio (DBH/plot radius)	Plot Radius Factor (PRF)
5	73.66	2.14	1/46.7	3.889
10	104.18	3.03	1/33.0	2.750
15	127.59	3.71	1/26.9	2.245
20	147.34	4.29	1/23.3	1.944
25	164.73	4.79	1/20.9	1.739
30	180.46	5.25	1/19.0	1.588
35	194.92	5.67	1/17.6	1.470
40	208.38	6.07	1/16.5	1.375
50	232.99	6.79	1/14.8	1.230
60	255.23	7.44	1/13.5	1.123

Point Sampling Inventories: Application



Another way to work this out when using non-standard BAFs is:

$BAF = 10{,}890\ (D/R)^2$
So for BAF = 28

$(D/R) = 0.0507$

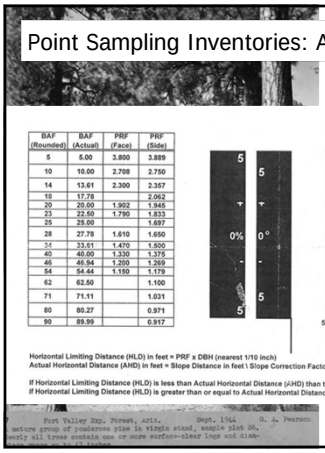
We can work out the maximum (or limiting) distance a tree can be at to be in the plot

$R = D/0.0507$

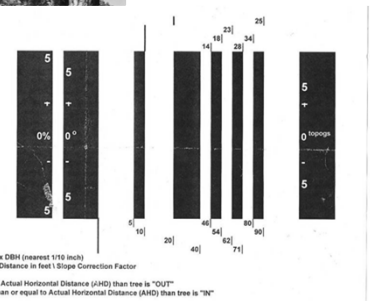
For example a 10” tree will be “in” if within:

$R = 10/0.0507 = 197” = 16.4$ feet

Point Sampling Inventories: Application



BAF (Rounded)	BAF (Actual)	PRF (Face)	PRF (Side)
5	5.00	3.800	3.889
10	10.00	2.708	2.750
14	13.61	2.300	2.357
18	17.78		2.062
20	20.00	1.902	1.945
23	22.50	1.790	1.833
25	25.00		1.697
28	27.78	1.610	1.650
34	33.61	1.470	1.500
40	40.00	1.330	1.375
46	46.94	1.200	1.269
54	54.44	1.150	1.179
62	62.50		1.100
71	71.11		1.031
80	80.27		0.971
90	89.99		0.917



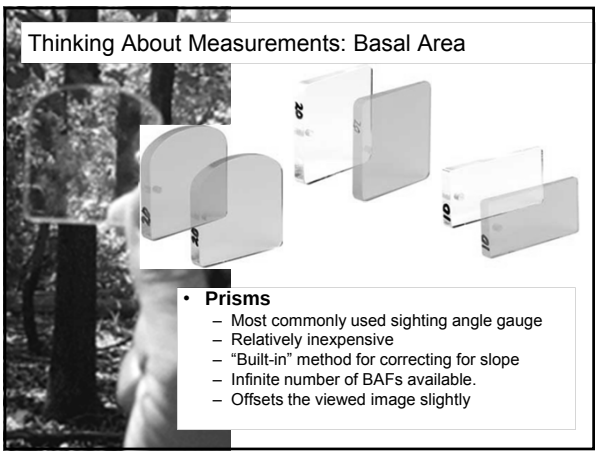
Horizontal Limiting Distance (HLD) in feet = PRF x DBH (nearest 1/10 inch)
Actual Horizontal Distance (AHD) in feet = Slope Distance in feet \ Slope Correction Factor

If Horizontal Limiting Distance (HLD) is less than Actual Horizontal Distance (AHD) than tree is "OUT"
If Horizontal Limiting Distance (HLD) is greater than or equal to Actual Horizontal Distance (AHD) than tree is "IN"

Thinking About Measurements: Basal Area

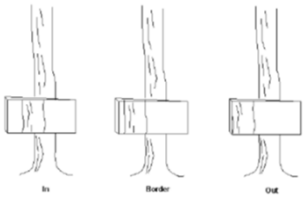
Measuring Basal Area: Using Your Angle Gauge

Thinking About Measurements: Basal Area



- **Prisms**
  - Most commonly used sighting angle gauge
  - Relatively inexpensive
  - "Built-in" method for correcting for slope
  - Infinite number of BAFs available.
  - Offsets the viewed image slightly

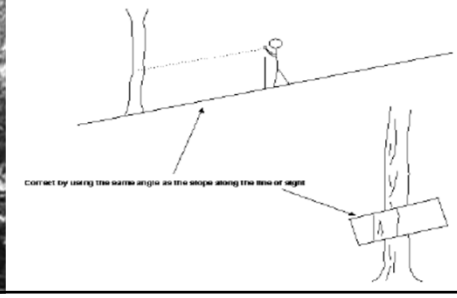
Thinking About Measurements: Basal Area



- Trees is counted if its image overlaps the image seen above and below the prism
- Borderline trees
- Trees not counted if image does not overlap

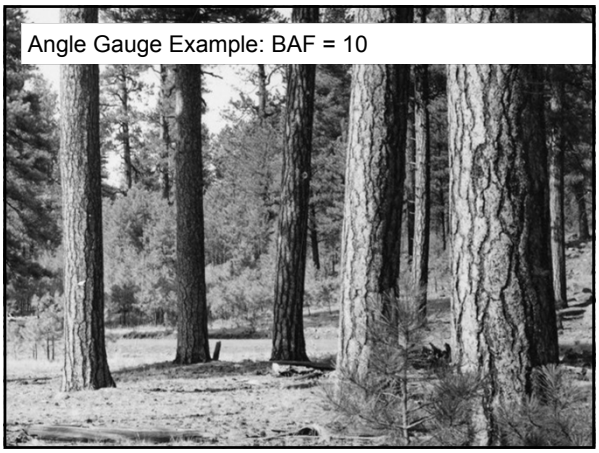
Thinking About Measurements: Basal Area

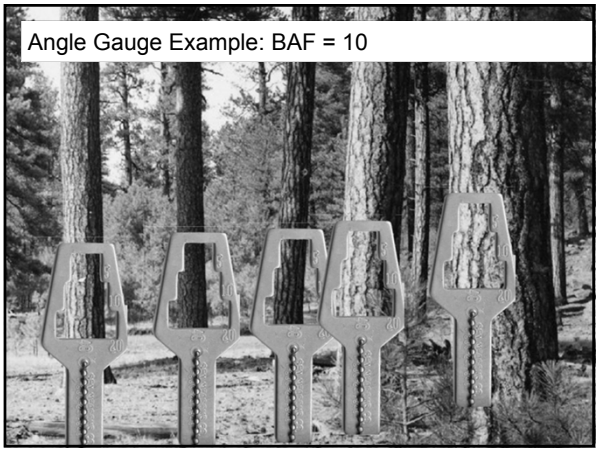
Prisms and Slope:

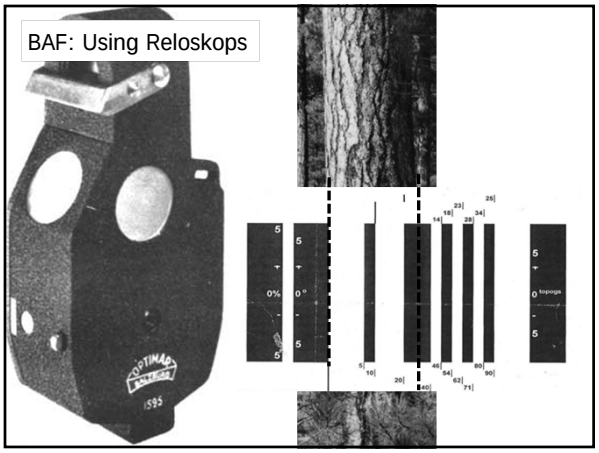


Basal Area: The Angle Gauge

- Select BA Factor (5, 10, 20, 40) to ensure tally of 5-12 trees
- Center eye over Plot Center
- Hold chain 'like an archer' and aim the gauge at the target trees' breast height
- Circle around plot center and aim gauge at tree's DBH
- If tree DBH > Angle Gauge Width ADD to tally
- BA/unit area = BAF * Tally


Angle Gauge Example: BAF = 10


Angle Gauge Example: BAF = 10


BAF: Using Reloskops

BAF: Using Reloskops