# Measurement of Tree Basal Area & Volume



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# **Today's Objectives**

- $\Box \quad \text{Tree} \rightarrow \text{Stand} \rightarrow \text{Forest}$
- Basic geometric calculations
- Measurement of tree diameter
- Measurement of tree height
- Determination of:
  - basal area
  - volume
  - biomass & carbon
  - \$ value

# Tree Basal Area



### Simply the cross-sectional area of a tree stem measured at breast height (1.4m)











- Basal area closely relates to volume
- **Easy to measure & calculate**
- Useful measure of *site occupancy*
- Useful to *forecast* future development of stand



Diameter is twice the radius

Radius = diameter / 2

Area of circle in terms of diameter is

area = pi \* (diameter/2)<sup>2</sup>

area = pi \* diameter<sup>2</sup> / 4

# Tree Basal Area



#### Convert diameter of a circle to area of a circle

area = pi \* diameter<sup>2</sup> / 4

Basal area =  $pi * (DBH)^2 / 4$ 

- But DBH is usually in *cm* & basal area is usually expressed in *square metres*
- □ 10000 *cm* per *square metre*



Basal area = pi \* (DBH)<sup>2</sup> / (4\*10000)

Basal area = pi \* DBH<sup>2</sup> / 40000

Where: basal area in in m<sup>2</sup> DBH is in cm





#### Forestry naming & unit convention

Basal area denoted by "BA"

**Basal area = in m^2** 

**Diameter at breast height = DBH in cm** 

#### Final form for basal area calculation

$$BA_{(m)}^{2} = pi * DBH_{(cm)}^{2} / 40000$$



- Volume of different portions of tree (know which one you are talking about)
- Total volume (main stem from ground to tip)
- Merchantable volume (main stem excluding stump and tip defined to a minimum diameter)





- Product content and tree value are directly related to tree volume
- Carbon and biomass are directly related to tree volume



- Water displacement
- Geometry of solid shape approximating tree stem shape
- Cut stem into sections, measure & sum



Either physically cut or measure sections on uncut stem

### How? Geometry of solid shape approximating tree stem shape

g = cross sectional area of base; h = height; v = volume





- Tree form a mix of all these shapes
- Shape changes along tree stem

So we calculate the form factor using stem analysis



**How? D** Section tree (either cut or mark)

Measure each section to calculate volume



Sum all sections to obtain tree total

Perform for many trees across range of sizes



E.g. for Noonan (Kershaw)

V = 0.42 \* BA \* H

Where: V = tree volume (m3)
BA = tree basal area (m2)
H = tree height (m)



How?

Sometimes more complex equations are developed

V = D<sup>a</sup> \* [H<sup>2</sup>/(H-1.4)]<sup>b</sup> \* e<sup>c</sup>

How?

# Sometimes tables are constructed that list volume by DBH & height

DBH	Spruce		Fir	
	Height	Volume	Height	Volume
Class	(m)	(m^3)	(m)	(m^3)
2	2.2	0.000	2.0	0.000
4	4.2	0.003	3.9	0.003
6	6.0	0.009	5.6	0.008
8	7.6	0.020	7.2	0.019
10	9.1	0.037	8.6	0.034
12	10.5	0.060	10.0	0.055
14	11.8	0.090	11.2	0.082
16	12.9	0.128	12.4	0.116
18	14.0	0.173	13.4	0.156
20	14.9	0.226	14.4	0.203
22	15.8	0.286	15.3	0.257
24	16.6	0.355	16.1	0.318



# Know

- Volume equations allow you to calculate tree volume from tree diameter and height
- □ They can be *complex* and very *accurate*
- Rough-and-ready *approximation*

V = 0.42 \* g \* h

Volume tables allow you to "look up" tree volume from tree diameter and height