

Tree & Stand Measurement



University of New Hampshire
Cooperative Extension

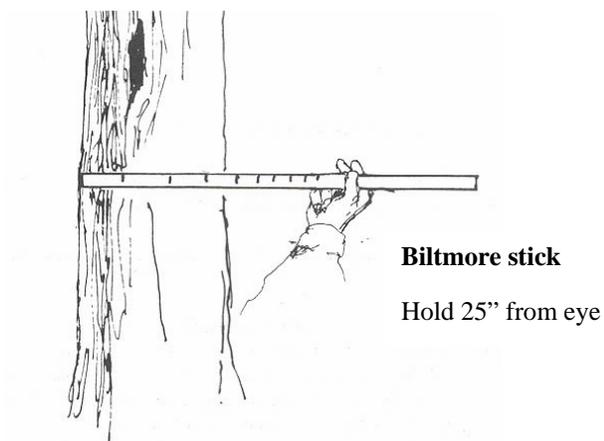
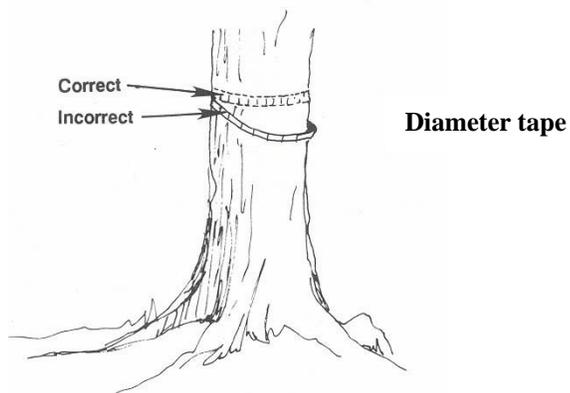
This guide was developed for use during a “Tree Measurement Workshop” sponsored by UNH Cooperative Extension, NH Timber Harvesting Council & NH Timberland Owners’ Granite State Woodland Institute. 6/02

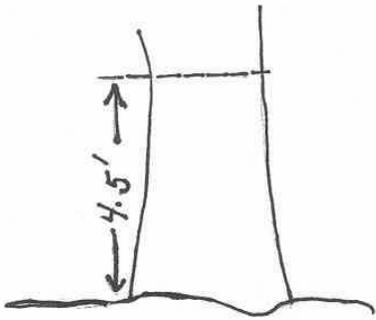
Tree Measurement

Diameter Measurement

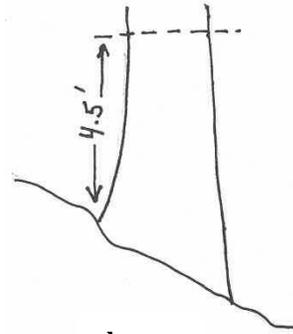
Tree diameters are measured at DBH or Diameter breast height (4.5 feet from base of the tree).

The most common (and practical) tools used to measure dbh are the diameter tape (d-tape) and the Biltmore stick.

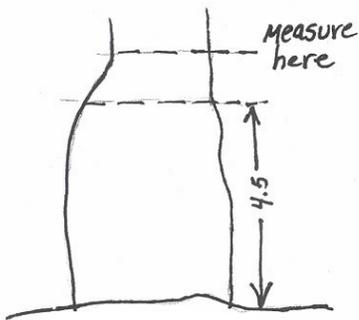




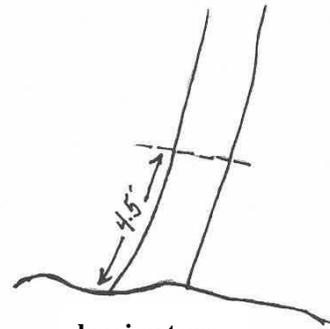
level ground



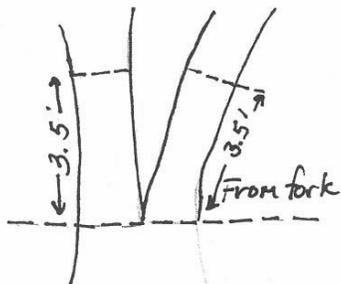
slope



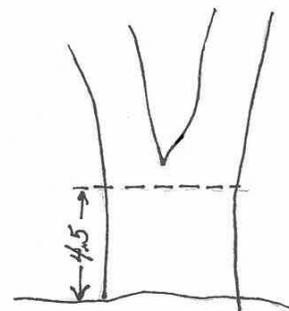
deformed base



leaning tree



fork below 4.5'



fork above 4.5'

Height Measurement

The total height (in feet) of a tree may at times be important. But, for most loggers, the amount of merchantable wood is what is of interest.

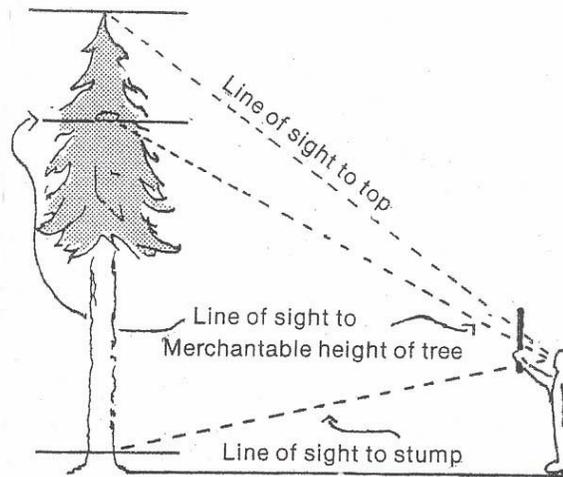
Total Tree Height

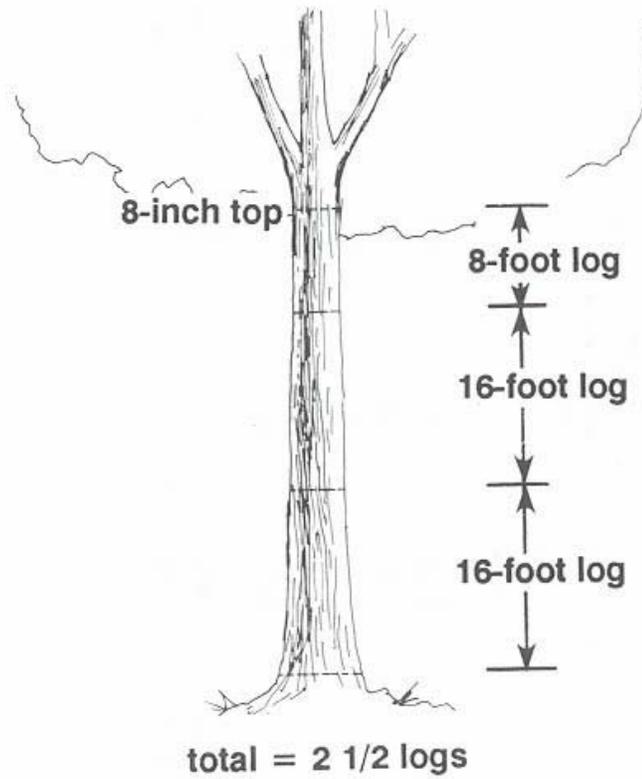
To determine the total height of a tree a clinometer is used. The clinometer measures the amount of rise in 100 feet. So the user paces out 100 feet, sights on the top of the tree and the stump and reads the scale on the clinometer. If viewer is uphill from the stump, measure from stump to eye level and add to tree height. If downhill, subtract. (See Figure 1)

Merchantable height

To determine the number of sawlogs or pulpwood in a tree use the Biltmore stick. On one edge is something called a hypsometer which, like the clinometer triangulates the height but in this case in 16' foot (or partial) logs.

To use the hypsometer, pace 66 feet (1 chain) from the tree. Hold the stick at 25" from eye and line bottom of stick with stump - read number of logs or partial logs. (See Figure 1)





Determining the number of sawlogs in main stem of tree

TREE SCALE
(International ¼ Inch)

DBH	Number of 16-Foot Logs							
	½	1	1 ½	2	2 ½	3	3 ½	4
	Contents in Board Feet							
12"	30	60	80	100	120			
14"	40	80	110	140	160	180		
16"	60	100	150	180	210	250	280	310
18"	70	140	190	240	280	320	360	400
20"	90	170	240	300	350	400	450	500
22"	110	210	290	360	430	490	560	610
24"	130	250	350	430	510	590	660	740
26"	160	300	410	510	600	700	790	880
28"	190	350	480	600	700	810	920	1020
30"	220	410	550	690	810	930	1060	1180
32"	260	470	640	790	940	1080	1220	1360
34"	290	530	730	900	1060	1220	1380	1540
36"	330	600	820	1010	1200	1380	1560	1740
38"	370	670	910	1130	1340	1540	1740	1940
40"	420	740	1010	1250	1480	1700	1920	2160
42"	460	820	1100	1360	1610	1870	2120	2360

Rule-of-Thumb for Determining Volume

3-Log Trees: DBH x DBH

More than 3-log tree: DBH (DBH + 3 for each ½ log above 3 logs)

Less than 3-log tree: DBH (DBH – 3 for each ½ log under 3 logs)

PULPWOOD MEASUREMENT

Cords

DBH	8-Foot Sticks						
	1	2	3	4	5	6	7
6"	.018	.030	.043				
8"	.032	.050	.070	.092			
10"	.049	.074	.101	.132	.167	.200	.239
12"	.070	.100	.138	.180	.225	.271	.324
14"	.095	.134	.179	.233	.291	.351	.419
16"	.120	.168	.222	.290	.361	.437	.521
18"	.146	.208	.270	.350	.439	.531	.634
20"	.186	.246	.320	.416	.522	.632	.755
22"	.220	.294	.374	.494	.612	.739	.883

Tons*

DBH	8-Foot Sticks						
	1	2	3	4	5	6	7
6"	.045	.075	.108				
8"	.080	.125	.175	.230			
10"	.123	.185	.253	.330	.418	.500	.598
12"	.175	.250	.345	.450	.563	.678	.810
14"	.238	.335	.448	.583	.728	.878	1.048
16"	.300	.420	.555	.725	.903	1.093	1.303
18"	.365	.520	.675	.875	1.098	1.328	1.585
20"	.465	.615	.800	1.040	1.305	1.580	1.888
22"	.550	.735	.935	1.235	1.530	1.848	2.208

*Conversion Factor: 1 Standard Cord = 2.5 Tons

To find weight for a certain species: (1) determine cords; (2) find species in table on page ; (3) multiply cords by ratio for that species.

Stand Measurement

Forest Stands are measured for a variety of reasons including forest management planning, forest health monitoring and timber appraisal.

Each objective requires different information and level of detail.

Because it is not practical to measure an entire forest, most land managers use sampling techniques or small sample plots to gather information about an entire forest. A timber cruise (cruising) is a sampling technique that when applied systematically, is surprisingly accurate.

1. To plan a cruise you need some basic information
 - a good base map with boundaries, aerial photos are also useful.
 - A sense of the variation (of timber types) within the stand. Walk around the stand to assess whether the forest is uniform (for example a pure white pine stand) or has a lot of variation.
2. Establish sample points
 - Forest measurement specialists feel a 10% cruise in a typical NH stand requires 30 points. If the stand has a lot of variability more points should be taken.

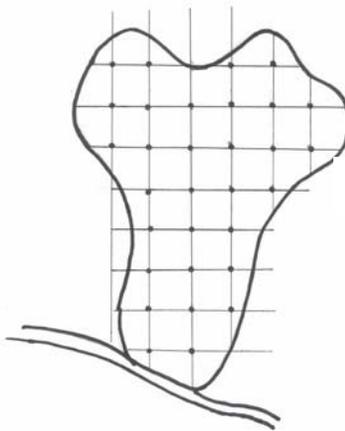


Figure 2

-On your map draw grid lines – usually referenced to a corner (see Figure 2)

- Point centers must be evenly spaced across stand. Do not bias the sample by moving points into more desirable areas.
 - The acreage is not as important to the number of points as the variability within the stand is. Start with 30 points. If the stand is variable add more points.
 - The distance between the points will be based on the scale of the map. Use a compass and pace (or tape) to move from one point to another.
3. Collect data at sample point
Tools needed: compass, measuring tape, prism (description below), diameter tape or Biltmore stick, hypsometer, tally sheet.

<p>Using a prism: A. A tally tree. Count B. A borderline tree. Count everyone other one. C. This tree is out. Don't count</p>

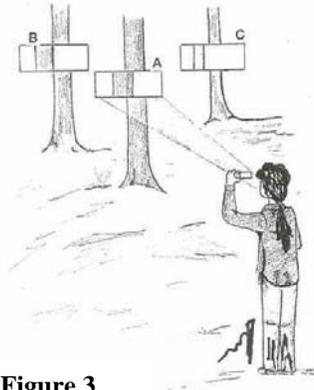


Figure 3

- at point, you may want to poke a flagged stick into the ground (temporarily) to call the point, hold prism over the point and look at trees in a circle around the point. (see **Figure 3** above)
 - if tree is in, measure its diameter, merchantable height in logs. Record on tally sheet. Use a new tally sheet for each plot. Volumes may be recorded in the field or at office using Tally Sheet chart on page 9
4. Summarize data
- Use the shortcut formulas to determine volumes per acre.

SHORTCUT FORMULAS

FOR

Cruising with 10-factor prism or gauge

SAWTIMBER

(INTERNATIONAL RULE)

1. When trees average 1 or 2 16-foot logs:

$$\frac{\text{Number of 16-foot logs in countable trees} \times 650}{\text{Number of point samples}} = \text{Board feet per acre}$$

2. When trees average 2 ½ or more 16-foot logs:

$$\frac{\text{Number of 16-foot logs in countable trees} \times 600}{\text{Number of point samples}} = \text{Board feet per acre}$$

SHORTCUT FORMULAS

for

Cruising with 10-factor prism or gauge

PULPWOOD

(CORDS)

1. $\frac{\text{Number of 8-foot sticks in countable trees} + \text{number of countable trees}}{2 \times \text{number of point samples}} = \text{Cords per acre}$

2. If trees average 2 or 3 sticks:

$$\frac{\text{Number of 8-foot sticks in countable trees} \times .7}{\text{Number of point samples}} = \text{Cords per acre}$$

If trees average 4 sticks or more:

$$\frac{\text{Number of 8-foot sticks in countable trees} \times .6}{\text{Number of point samples}} = \text{Cords per acre}$$

3. Cords figure can be converted to tons:

A cord of softwood weighs between 2.2 – 2.4 tons/cord

A cord of hardwood weighs between 2.5 – 2.7 tons/cord

Basal Area

Most New Hampshire loggers have heard the term basal area in relation to the NH timber harvesting laws.

Basal area is the cross sectional area of the stem at 4 ½ feet or breast height. (See Figure 4)

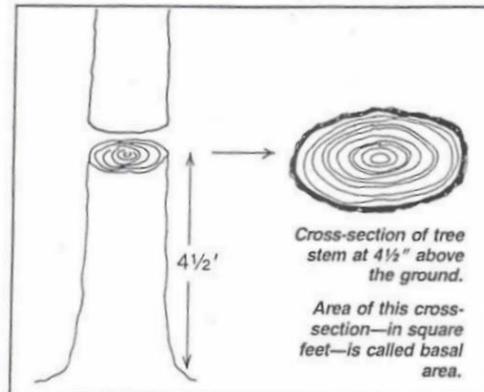


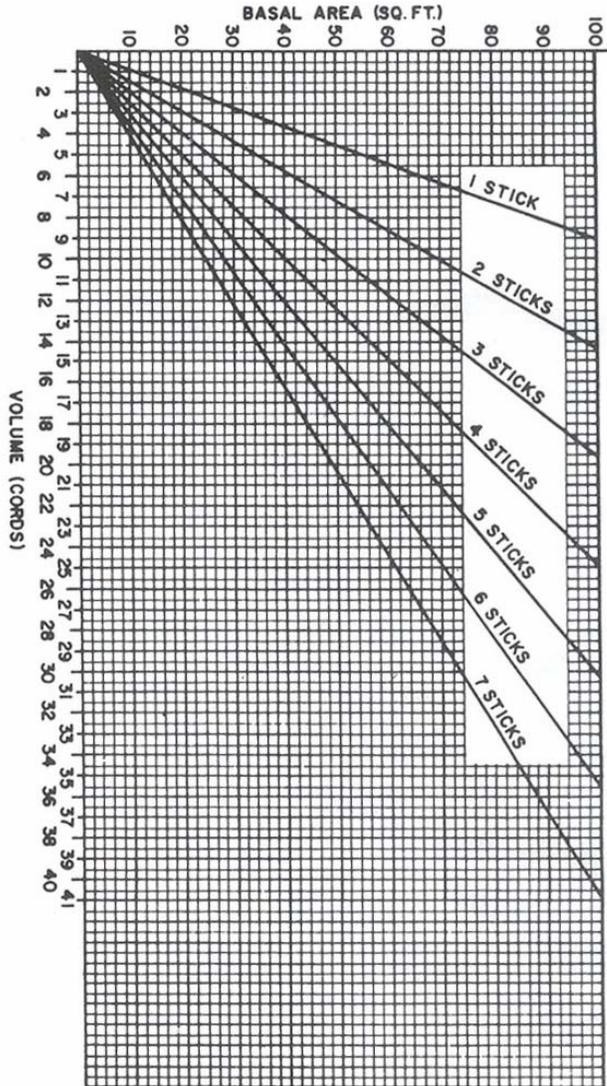
Figure 4

Basal area is also used by foresters to express the density or crowding within the forest. The prism is also used. To determine Basal area per acre the cruiser simply counts the number of trees that are “in at the point” and multiplies it by the prism factor x10, x15, x20 etc. The average basal area per acre figures can be compared with published “stocking guides” giving to the forest manager guidance on what the best density is for a given stand.

QUICK CRUISE COMPUTER

VOLUME - CORDS
(1 STICK = 8 FT.)

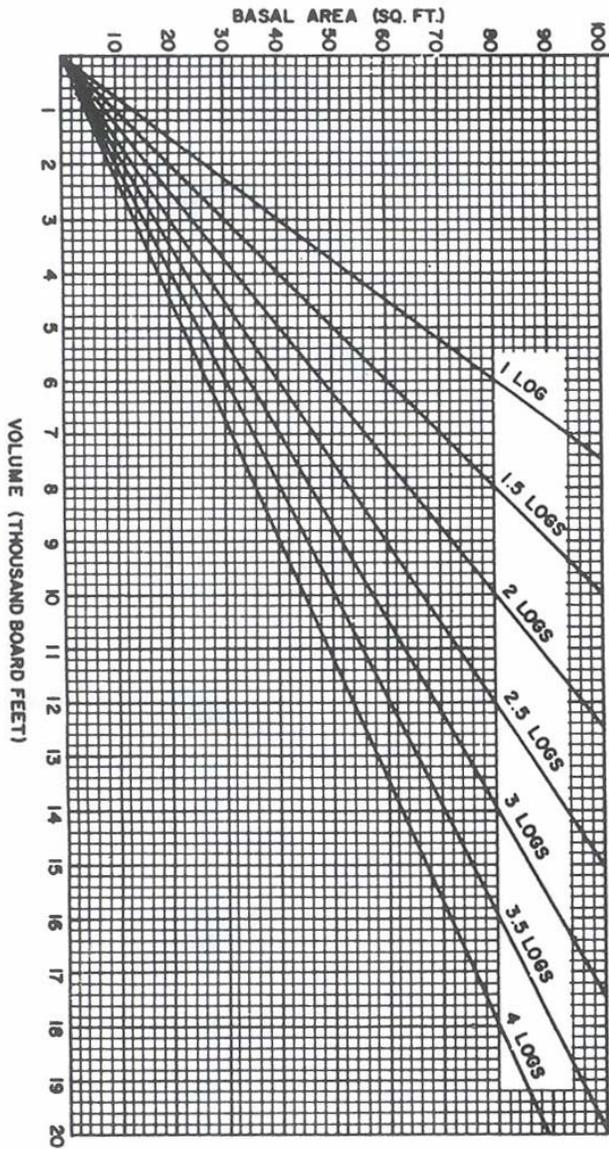
NA - S & PF
FOREST SERVICE
USDA



QUICK CRUISE COMPUTER

(VOLUME-BOARD FEET - INT.)
(1 LOG = 16 FT.)

NA - S & PF
FOREST SERVICE
USDA



Log Length

Diameter (inches)	Length of Log (feet)					
	6	8	10	12	14	16
	Contents in Board Feet					
6	5	10	10	15	15	20
7	10	10	15	20	25	30
8	10	15	20	25	35	40
9	15	20	30	35	45	50
10	20	30	35	45	55	65
11	25	35	45	55	70	80
12	30	45	55	70	85	95
13	40	55	70	85	100	115
14	45	65	80	100	115	135
15	55	75	95	115	135	160
16	60	85	110	130	155	180
17	70	95	125	150	180	205
18	80	110	140	170	200	230
19	90	125	155	190	225	260
20	100	135	175	210	250	290
21	115	155	195	235	280	320
22	125	170	215	260	305	355
23	140	185	235	285	335	390
24	150	205	255	310	370	425
25	165	220	280	340	400	460
26	180	240	305	370	435	500
27	195	260	330	400	470	540
28	210	280	355	430	510	585
29	225	305	385	465	545	630
30	245	325	410	495	585	675

FORMULA: $.05 (D-1)^2 \times L$