

Tools for Measuring Your Forest

S. Bowers

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Woodland owners routinely want to measure property acreage, boundaries, ground slope, various characteristics of standing timber, and individual log volumes.

Different tools are required for each of these tasks (Figure 1).

Forests and forest products can be measured efficiently and precisely with sophisticated, and often expensive, instruments.

However, most measurements can be made with a few simple and inexpensive tools.

This publication discusses only those tools that are readily available, affordable, and appropriate for a woodland owner who has basic measurement skills.

Table 1 (page 5) compares the accuracy and convenience of each type of tool for taking certain measurements.



Figure 1.—Tools you'll use for some measuring tasks are (clockwise, from top left) a clinometer, a compass, an increment borer (with flagging tape attached, to make the borer easier to find if it falls on the ground), and a combination logger's tape.

The tools and how they work

Angle gauge A mechanical or optical device for measuring basal area of trees in variable-plot sampling; that is, sampling a plot containing trees of various sizes. The most common is a wedge prism, a precisely ground glass wedge that is calibrated in basal area factors (BAF) from 10 to 70. Most woodland owners use a prism with a BAF scale between 20 and 40. Average tree diameter and prism BAF are directly proportional—as average tree diameter increases, prism BAF increases also.

*Steve Bowers, Extension forester,
 Lane County, Oregon State
 University.*



Figure 2.—The clinometer has a sighting hole and a suspended circular scale that can measure ground slope as well as tree height.

Clinometer A rugged, hand-held instrument for measuring vertical angles such as ground slope, road grade, and tree height (Figure 2). Various models have degree and percent scales, percent and topo scales, or degree and topo scales. Recommended models include those containing the degree and percent scales. When using the degree scale, at a distance of 100 feet from the

tree, heights can be measured directly, and slope is an easy calculation.

Combination logger's tape A steel tape with a spring/spool rewind containing measurements in various combinations on both sides of the tape. The recommended tape contains a combination of tree diameter in inches on one side with the other side measuring length in feet and inches (Figure 3). Standard tapes come in 50-, 75-, and 100-foot lengths. The 50-foot tape is recommended for use in logging, but if you are going to use the tape exclusively for tree measurements, the 100-foot tape is best.

Compass A hand-held compass is a relatively rugged instrument that measures horizontal angles or direction in degrees (Figure 4). Compasses are used most often when following transect lines to establish plots for timber measurements or cruise estimates and in determining boundary or property

lines. Placing the compass on a solid, nonmetal object can give more precise readings. Compasses are available in azimuth (0° to 360°) or quadrant (0° to 90°). Most woodland owners find the azimuth easier to use.

Global Positioning System (GPS) This is a general term that refers to various hardware and software used to locate certain points on the earth, such as property and unit boundaries, acreages, roads, and elevations (Figure 5). GPS technology uses a receiver and a data logger to capture and interpret electronic signals transmitted from satellites that orbit the earth. Location can be determined very accurately through GPS, but accuracy depends on the quality of the receiver, satellite reception,



Figure 4.—Hand compasses such as this typical model are used to measure horizontal angles.



Figure 3.—A combination logger's tape can measure tree diameter (above left) in addition to log lengths and diameters (above right).

topography, canopy cover, and other factors. In forests, canopy cover may interfere with satellite reception and make it difficult to take reliable measurements.

Increment borer This is a hand-operated drill with a hollow bit that extracts a wood core from the stem of a tree (Figure 6). Wood core samples are used in determining tree growth, age, and general health. Borer length varies in 2-inch increments, from an 8-inch minimum to a 16-inch maximum sampling depth. The largest is adequate for conveniently determining the age of trees up to about 30 inches in diameter (including bark). Most woodland owners use the 8-, 10-, or 12-inch borers.

Log volume tables A single sheet or an entire book that lists log volumes for each log length and scaling diameter (Table 2, page 6). Tables are available in board-foot and cubic-foot measures. Oregon State University Extension publication EC 1127, *Measuring Timber Products Harvested from Your Woodland* (see back page), also contains log volume tables.

Pacing This is a skill rather than a tool, but it can be—and commonly is—substituted for tools when horizontal distance measurements do not need to be precise (Figure 7, page 4). The best way to determine your pace is to count your steps as you walk an accurately measured distance

Figure 5.— The cost of a GPS unit ranges widely, from a few hundred dollars to several thousand. Less costly hand-held models are used for hiking and hunting as well as for forestry applications such as riparian and timber boundaries. More precise measurements involving legal descriptions or property boundaries require trained and licensed individuals using expensive GPS units. High-end units most likely are not practical or cost effective for the average woodland owner.



using the same kind of pace you use for everyday walking.

Rangefinder This convenient optical device provides horizontal measurements that are more precise than most pacing but less precise than taping. Rangefinders are particularly useful when a person is working alone.

Topographic map

A map that shows terrain (ridges, draws, and flat areas) by contour lines. The contour lines indicate locations of equal elevation and make it possible to measure the slope of the ground from the map. Widely spaced contour lines indicate flat or gentle ground; closely spaced lines indicate steep ground.

Tarif access tables

Tables that list the tarif number for individual tree species, such as Douglas-fir (Table 3, page 7)



Figure 6.—A core sample obtained from a tree with the incremental borer enables the user to determine a tree's growth rate.

based on total tree height and diameter at breast height (dbh). A low tariff number means the tree has much taper; a high tariff number means it has minimal taper. For details, and more tariff access tables, see OSU Extension publication EC 1190, *Stand Volume and Growth: Getting the Numbers* (see back page).

Tree volume tables Tables that list the wood volume of individual tree species in board-foot or cubic-foot volumes. Table 2, a sample, is based on tariff number, log length, and dbh for each tree. More tree volume tables are in *Stand Volume and Growth: Getting the Numbers*.

The Woodland Stick Any of several sticks or other devices to help you make simple and relatively accurate estimates of tree height and diameter (Figure 8). The Woodland Stick also contains an abbreviated log volume table for determining Scribner log volumes in standing trees.

Comparing the tools

Use Table 1 to compare tools that can be used for similar tasks. First, check the key at the bottom. The three numbers indicate the degree of precision and the degree of difficulty in use. Determine what you want to measure and consider all the tools in the



Figure 8.—The Woodland Stick is an easy-to-use and moderately accurate tool for measuring tree height and diameter. It must be held 25 inches from the eye; at any other distance, it gives incorrect readings.

Figure 7.—Pacing can be a fast, easy way to estimate area and horizontal distances. However, pacing accuracy can range widely, with results from moderately accurate to very crude. Practice in order to develop a consistent pace. You might want to buy a pedometer, such as those sold in sporting goods stores, to count your paces.



left column. Some are quick and easy to use but yield less precise results. Others are more difficult to use—and may or may not give more precise results.

Select a tool that fits the objective. For example, if you want to measure a road grade, you can choose between a clinometer and a topographic map.

The clinometer is rated at 2 for precision (that is, moderately precise) and 2 for ease of use (that is, moderately easy to use).

The topographic map is rated 1 for precision in measuring road grade (that is, less precise than the clinometer), and it's rated 2 for ease of use (moderately easy to use).

Considering both methods of measurement, the clinometer would be the better option because it has a better degree of precision and is equally easy to use.

Tools discussed here are available from many sources. Most are stocked in local reforestation or logging supply stores; others can

be obtained from mail-order suppliers. Tool and supply catalogs are available in many county Extension offices.

A tool purchased new usually comes with instructions, but novices frequently

need help with certain instruments. Ask the Extension forester in the OSU Extension office nearest you for additional publications or other sources of assistance.

Table 1.—Rating precision and convenience of tools for various measuring tasks

Tools	Precision Ease of use	Measurement tasks													
		Boundaries					Logs			Trees					
		Area	Horizontal angles	Horizontal distances	Road grade	Ground slope	Diameter	Length	Volume	Age	Basal area	Current growth	Diameter	Volume	Height
Angle gauge	Precision Ease of use										2 2				
Clinometer	Precision Ease of use				2 2	2 2									2 2
Compass	Precision Ease of use		2 2												
Global Positioning System (GPS) ¹	Precision Ease of use	3 1	2 1	3 1		1 1									
Increment borer	Precision Ease of use								3 2		3 2				
Logger's tape ²	Precision Ease of use	2 2		2 3			3 3	3 3					3 3		
Log volume table	Precision Ease of use								3 3						
Pacing	Precision Ease of use	1 3		1 3											
Rangefinder	Precision Ease of use			3 2											
Tarif access tables ³	Precision Ease of use													3 2	
Topographic map	Precision Ease of use					1 2	1 2								
Woodland Stick	Precision Ease of use							2 3					2 3	1 3	2 3

Precision: 1= less precise; 2 = moderate; 3 = more precise

Ease of use: 1 = difficult to use; 2 = moderate; 3 = easy to use

¹Global Positioning Systems (GPS) come in a wide price range; price directly relates to accuracy.

²Logger's tape cartridge with feet and inches on one side and tree diameter (inches) on other side.

³Tarif access tables include tarif tables for individual species and tree volume table.

Table 2.—Tree volume table (Scribner volume table, 32' logs to 5" top).¹

		Tariff numbers																																				
		15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45						
7	DH (inches)	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	20	20	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	
8		10	10	10	10	10	10	10	10	10	10	30	30	30	30	30	30	30	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	
9		20	20	20	20	20	20	20	20	20	30	30	30	30	30	30	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	
10		20	20	20	20	20	20	20	20	20	30	30	30	30	30	30	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	
11		20	20	20	20	20	20	20	20	20	30	30	30	30	30	30	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	
12		20	20	20	20	20	20	20	20	20	30	30	30	30	30	30	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40
13		20	20	20	20	20	20	20	20	20	30	30	30	30	30	30	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40
14		30	30	30	30	30	30	30	30	30	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40
15		30	30	30	30	30	30	30	30	30	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40
16		30	30	30	30	30	30	30	30	30	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40
17		50	60	70	90	90	110	100	110	140	140	140	140	150	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170
18		60	70	80	90	110	100	130	140	140	140	160	160	170	170	190	190	190	190	190	190	190	190	190	190	190	190	190	190	190	190	190	190	190	190	190	190	190
19		70	80	80	110	130	140	160	160	160	160	190	190	190	190	190	190	190	190	190	190	190	190	190	190	190	190	190	190	190	190	190	190	190	190	190	190	190
20		70	80	110	130	130	160	160	160	180	190	190	190	220	220	220	240	240	240	240	240	240	240	240	240	240	240	240	240	240	240	240	240	240	240	240	240	240
21		80	80	110	140	130	160	160	180	180	190	220	220	220	280	280	290	300	310	310	310	310	310	310	310	310	310	310	310	310	310	310	310	310	310	310	310	310
22		80	100	140	140	150	180	180	180	220	220	220	260	260	280	300	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360
23		80	110	140	160	170	180	210	210	220	260	260	260	330	330	350	360	380	380	380	380	380	380	380	380	380	380	380	380	380	380	380	380	380	380	380	380	380
24		100	140	160	150	180	210	210	250	260	260	310	310	310	330	390	400	420	420	420	420	420	420	420	420	420	420	420	420	420	420	420	420	420	420	420	420	420
25		100	140	160	170	210	210	250	260	310	310	310	370	390	400	400	420	420	420	420	420	420	420	420	420	420	420	420	420	420	420	420	420	420	420	420	420	420
26		130	160	180	170	210	250	250	310	310	350	350	370	440	450	470	500	510	530	590	590	590	590	590	590	590	590	590	590	590	590	590	590	590	590	590	590	590
27		130	160	180	200	250	250	300	310	350	350	400	420	440	450	530	560	590	590	590	590	590	590	590	590	590	590	590	590	590	590	590	590	590	590	590	590	590
28		130	180	210	200	250	300	340	350	350	400	420	490	510	530	560	590	640	660	660	660	660	660	660	660	660	660	660	660	660	660	660	660	660	660	660	660	660
29		150	180	210	240	300	340	340	400	400	460	480	500	560	580	610	640	660	660	660	660	660	660	660	660	660	660	660	660	660	660	660	660	660	660	660	660	660
30		150	180	250	240	300	340	390	400	460	460	530	550	580	610	710	740	740	770	770	770	770	770	770	770	770	770	770	770	770	770	770	770	770	770	770	770	770
31		150	210	250	290	340	390	390	460	460	510	530	640	660	690	710	740	740	740	740	740	740	740	740	740	740	740	740	740	740	740	740	740	740	740	740	740	740
32		150	210	250	330	340	390	450	460	510	590	620	640	710	760	780	790	820	860	860	860	860	860	860	860	860	860	860	860	860	860	860	860	860	860	860	860	860
33		170	210	300	330	390	450	500	510	590	590	670	690	740	760	850	880	920	980	980	980	980	980	980	980	980	980	980	980	980	980	980	980	980	980	980	980	980
34		170	250	300	330	450	450	500	590	590	640	670	770	800	820	850	880	1000	1060	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100
35		170	250	340	380	450	500	580	590	640	660	730	770	820	920	960	1000	1050	1100	1160	1230	1240	1320	1340	1340	1340	1340	1340	1340	1340	1340	1340	1340	1340	1340	1340	1340	1340
36		170	250	340	380	500	580	580	640	700	720	820	850	900	920	1020	1060	1110	1160	1210	1230	1310	1450	1530	1560	1560	1560	1560	1560	1560	1560	1560	1560	1560	1560	1560	1560	1560

¹Condensed from VARPLOT Scribner Volume Tables.

Table 3.—Tariff access table for Douglas-fir.¹

DBH (inches)	Height (feet)																													
	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120	125	130	135	140	145	150	155	160	165	170	
7	15	17	20	23	26	29	31	33	37	40	42	44																		
8	15	17	19	22	25	27	30	32	35	38	39	42	44																	
9	15	16	18	21	24	25	28	30	33	36	38	40	41	45																
10	15	17	21	22	25	27	29	31	34	36	38	40	43	45																
11	15	17	19	21	24	27	28	30	32	35	37	39	41	43	45															
12	15	16	18	21	23	25	27	29	31	34	36	38	40	42	44															
13	15	16	18	21	22	24	27	29	30	32	34	36	39	41	42	45														
14	15	17	19	21	24	25	28	30	32	34	36	38	40	41	43	45														
15	15	17	19	21	23	25	27	29	31	33	34	37	39	40	42	44														
16	15	16	18	21	23	24	27	28	30	32	34	36	38	39	41	43	45													
17	15	16	18	21	22	24	27	28	29	31	33	35	38	39	41	42	44													
18	15	16	18	19	21	23	25	27	29	31	32	34	36	38	40	41	43	45												
19	15	17	19	21	23	25	27	28	30	32	34	36	38	39	41	42	44													
20	15	17	18	21	22	24	27	28	29	31	33	35	36	38	40	42	43	45												
21	15	17	18	21	22	24	25	27	29	31	32	34	36	38	39	41	43	44												
22	15	16	18	19	21	23	25	27	28	31	32	33	35	37	38	40	42	43	45											
23	15	16	18	19	21	23	25	27	28	30	31	33	35	36	38	40	41	43	44											
24	15	16	17	19	21	23	24	26	27	29	31	32	34	36	38	39	41	42	44	45										
25	15	16	17	19	21	22	24	26	27	29	30	32	34	35	37	38	40	42	43	45										
26	15	17	19	21	22	23	25	27	28	30	32	33	35	36	38	39	41	43	44											
27	15	17	19	21	22	23	25	26	28	30	31	33	35	36	38	39	41	42	43	45										
28	15	17	18	20	21	23	25	26	28	29	31	32	34	35	37	38	40	41	43	44										
29	15	16	18	19	21	23	24	26	28	29	30	32	33	35	37	38	39	41	42	44	45									
30	15	16	18	19	21	22	24	25	27	28	30	31	33	34	36	38	39	40	42	43	45									
31	15	16	17	19	21	22	24	25	27	28	30	31	33	34	35	37	38	40	41	43	44									
32	15	16	17	19	21	22	23	25	27	28	29	31	32	34	35	37	38	39	41	42	44	45								
33	15	16	17	19	20	21	23	25	26	28	29	30	32	33	35	36	38	39	40	42	43	45								
34	16	17	19	20	21	23	24	26	27	29	30	32	33	34	36	38	39	40	41	43	44									
35	15	17	19	20	21	22	24	26	27	28	30	31	33	34	35	37	38	40	41	43	44	45								
36	15	17	18	19	21	22	24	25	27	28	29	31	33	34	35	37	38	39	41	42	44	45								

¹Condensed from VARPLOT Tree Volume Tariff Access Tables (2002).

For further information

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