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International Board-Foot Volume Tables for Trees in the Susitna River Basin, Alaska

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Abstract

International 1/4-inch board-foot volume equations and tables were derived from fall, buck, and scale data for 374 trees at 78 locations in the Susitna River Basin, Alaska. Tree species included white and black spruce, paper birch, black cottonwood, and quaking aspen.

Keywords: Volume tables, volume equations, white spruce, black spruce, paper birch, black cottonwood, quaking aspen, Susitna River Basin, Alaska.

Introduction

Several volume tables have been used to describe stand volume in the Susitna River basin, but none has been totally satisfactory. The most popular volume tables have been Haack's (1963), developed with data from throughout the interior of Alaska, and Kerr and Eleazer's (1980), which are Tyonek site specific. Our experience has been that Haack's tables tend to overestimate and Kerr and Eleazer's tend to underestimate tree volumes in the Sustina Valley.

A fall, buck, and scale study provided both an opportunity and the data to develop accurate tables specifically for the Susitna Valley.

International 1/4-inch board-foot volume equations were derived from an analysis of this fall, buck, and scale data obtained during a multiresource inventory of the Susitna River basin, Alaska (USDA, Soil Conservation Service 1986). Volumes are presented for combinations of diameter at breast height (dbh) and total tree height, and for dbh and height to a 6-inch top.

A total of 374 trees were used in the analysis: 208 white spruce (*Picea glauca* (Moench) Voss), 27 black spruce (*P. mariana* (Mill.) B.S.P.), 84 paper birch (*Betula papyifera* Marsh.), 13 quaking aspen (*Populus tremuloides* Michx.), and 42 black cottonwood (*P. trichocarpa* Torr. & Gray). Tables 1 through 6 list the distribution of sample trees by species and diameter classes. Data were collected at 78 randomly located plots in the Susitna River basin, an area roughly bounded by the Alaska Range to the north and west, the Talkeetna Mountains to the east, and Cook Inlet and Knik Arm to the south (fig. 1). Larson and Winterberger (1988) used the same trees to develop cubic-foot and Scribner board-foot volume tables.

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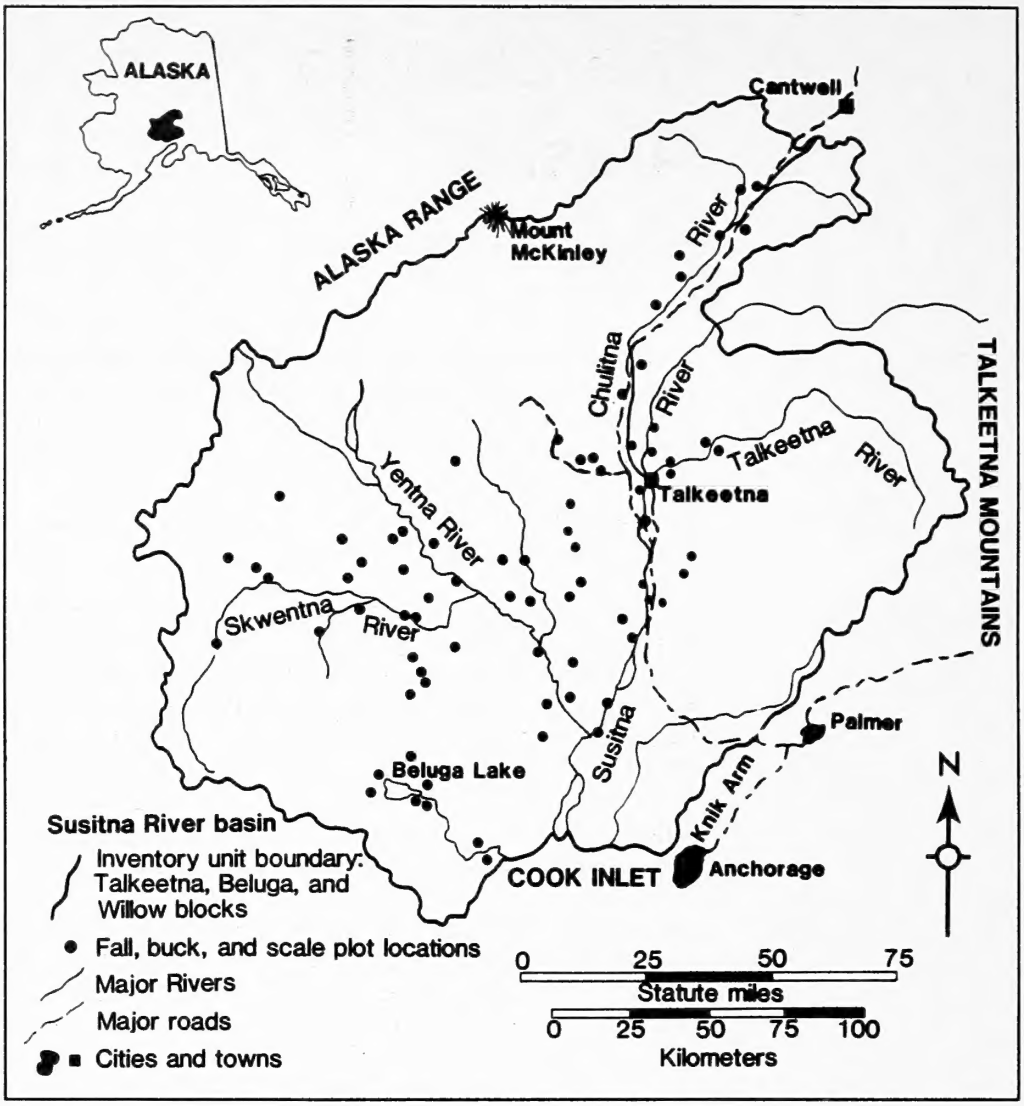

Figure 1—The Susitna River basin, Alaska, where fall, buck, and scale data were collected.

Methodology

Fall, buck, and scale sample trees were selected by using a 40-basal area factor prism rotated about points located 200 feet north of point 3; east of points 4, 5, and 6; south of point 7; and west of points 8, 9, and 10 of the forest survey 10-point inventory plots (USDA, Forest Service 1967). All tally trees greater than 5 inches dbh were destructively sampled. Each sample tree was measured and marked at the 1-foot stump and at breast height. After felling and limbing, total height and height to a 6-inch top diameter inside bark (dib) were recorded. The tree was bucked into 16.3-foot logs above the 1-foot stump and at the 6-inch top. If severe stem deformities occurred, such as forks, broken tops, or evidence of rot, additional cuts were made to isolate that portion of the stem. Two cross-sectional diameters were measured inside bark at each cut point along the stem with the second measurement taken at right angles to the first.

Tree data were used to build a data file consisting of species, dbh, total height, height to a 6-inch top, and International 1/4-inch board-foot volume. Deformed, cull trees, and trees with missing data or data obviously in error were eliminated. All merchantable portions of forked trees were included. Tree data were then examined to assure that the bucking was consistent with USDA, Forest Service, log scaling rules.[1] If a log segment was too short or too long because of attempts by field crews to isolate rot, then a portion of the next log was "added" or the log was "cut" to a standard length. A new diameter was calculated by assuming that logs were circular in cross section with linear taper between the existing end measurements.

Board-foot volumes were not computed for trees having less than 8 feet of height to a 6-inch top inside bark or for pieces with less than a 6-inch diameter inside bark at the small end. All top sections at least 2 feet long to a 6-inch top were included in volume calculations. Board-foot volumes, International rule, were computed from Clark's formula modified for 1/4-inch kerf and 4-foot sections (Chapman 1942):

$$\text{volume} = 0.905 \times (0.22 \times \text{diameter}^2 - 0.71 \times \text{diameter}) .$$

Plottings of volume over $dbh^2 \times$ height (ht) indicated that volumes were curvilinearly related. The independent variables tested therefore included dbh, dbh^2, ht, $dbh^2 \times ht$, 1/dbh, $1/dbh^2$, and $(dbh^2 \times ht)^c$, where c is an unknown coefficient.

FSCREEN[2] (Frayer and others 1971) was used to screen for the best independent variable or combination of independent variables of dbh and ht to predict volume. The term $(dbh^2 \times ht)^c$ was fitted after transformation with logarithms; for example, $\ln(\text{volume}) = b_o + b_1 \times \ln(dbh^2 \times ht)$. Both weighted (using the inverse of expected variance in volume) and unweighted linear regressions were tested as described by Furnival (1961) with various results. Weighted results were superior to unweighted as was expected. The logarithm transformation to obtain an equation with $(dbh^2 \times ht)^c$ avoids the need of weights because it tends to equalize variance in volume and linearize the relation.

Analysis of covariance was used to test the selected regressions for significant differences among all species. Equations for white and black spruce were not significantly different, nor were those for paper birch and quaking aspen. Equations for these two species groups therefore were pooled.

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[1] U.S. Department of Agriculture, Forest Service. Forest Service Manual, title 2400, Timber Management. Alaska Region Supplement 228. On file with: Alaska Region, Federal Office Building, Box 21628, Juneau, Alaska 99802 1628.

[2] The use of trade, firm, or corporation names in this publication is for the information and convenience of the reader. Such use does not constitute an official endorsement or approval by the U.S. Department of Agriculture of any product or service to the exclusion of others that may be suitable.

Discussion

The regression equation with the best fitting combination of variables for each species or species group was selected. These equations are presented at the bottom of the appropriate table followed by the increased efficiency of the equation used over the unweighted linear model, where volume = a + b(dbh^2ht). The standard error of the estimate is also presented. The shading in the tables indicates the limits of the data. The number of trees in each diameter class by species is also given.

Predicted board-foot volumes for white and black spruce (table 1) were generally lower than predicted volumes in other published tables (Dippold and Farr 1971, Farr 1967, Haack 1963) for total tree height in the range of tree data for all tables. Dippold and Farr's (1971) table for the Kuskokwim River Valley gives slightly lower volumes at the table extremes; that is, in small-diameter short trees and large-diameter tall trees. Farr's (1967) table for the Alaska interior presents slightly lower volumes at the high end of the table for large-diameter tall trees but much higher volumes at the low end of the table for small-diameter short trees. Haack's (1963) table presents slightly lower volumes at the low end of the table for small-diameter short trees.

The board-foot volumes for paper birch and quaking aspen (table 2) are slightly higher than those reported by Haack (1963) over the range of data. The differences are minimal in the center of the table and increase at both ends for small-diameter short trees and large-diameter tall trees.

The black cottonwood board-foot volumes (table 3) are consistently higher throughout the range of the table than those reported by Haack (1963) for balsam poplar (*Populus balsamifera* L.) in interior Alaska. Cottonwood and poplar are nearly identical in form and appearance and are difficult to distinguish without chemical analysis.

There are no published International board-foot tables for Alaska trees where height was measured to a 6-inch top diameter, so no comparisons could be made to previous work for tables 4, 5, and 6.

Table 1—Board-foot volume, International rule (1-foot stump to 6-inch top dib) given d.b.h. and total height for white spruce and black spruce, Susitna River basin, Alaska[a]

Dbh (d)[b]	Total height in feet (h)[c]															Trees measured[d]	
	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	White spruce	Black spruce
Inches	Board-foot volume															--Number--	
6	5.4	6.5	7.7	8.9	10.2	11.5	12.9	14.2	15.6							1	1
7	7.9	9.6	11.4	13.2	15.1	17.0	19.0	21.0	23.1	25.2	27.4					4	2
8	11.1	13.5	16.0	18.5	21.2	23.9	26.7	29.5	32.4	35.3	38.3					23	8
9	14.9	18.2	21.5	25.0	28.5	32.2	35.9	39.7	43.6	47.6	51.7					40	5
10	19.5	23.7	28.1	32.6	37.2	42.0	46.9	51.9	57.0	62.2	67.4					34	3
11	24.8	30.2	35.7	41.5	47.4	53.4	59.6	66.0	72.5	79.1	85.8	92.7				22	4
12	30.9	37.6	44.5	51.7	59.0	66.6	74.3	82.3	90.3	98.6	107.0	115.5	124.1	132.9		31	1
13	37.9	46.0	54.5	63.3	72.3	81.5	91.0	100.7	110.6	120.7	131.0	141.4	152.0	162.8		14	2
14	45.7	55.5	65.7	76.3	87.2	98.3	109.8	121.5	133.4	145.6	158.0	170.6	183.3	196.3		14	1
15	54.4	66.1	78.3	90.8	103.8	117.1	130.7	144.6	158.9	173.3	188.1	203.1	218.3	233.8		8	
16	64.0	77.8	92.2	107.0	122.2	137.9	153.9	170.3	187.0	204.1	221.5	239.1	257.0	275.2	293.7	8	
17	74.7	90.7	107.4	124.7	142.5	160.7	179.4	198.5	218.0	237.9	258.2	278.7	299.6	320.8	342.3	4	
18		104.9	124.1	144.1	164.6	185.7	207.3	229.4	252.0	274.9	298.3	322.1	346.2	370.7	395.6	4	
19					188.8	212.9	237.7	263.0	288.9	315.2	342.0	369.3	397.0	425.1	453.6		
20						242.4	270.6	299.5	328.9	358.9	389.4	420.5	452.0	484.0	516.4		
21							306.2	338.8	372.1	406.1	440.6	475.7	511.4	547.6	584.3		
22								381.1	418.6	456.8	495.6	535.1	575.2	615.9	657.2		
23									468.4	511.1	554.6	598.8	643.7	689.3	735.5		
24									521.7	569.2	617.6	666.9	716.9	767.6	819.1		
25									578.4	631.2	684.8	739.4	794.9	851.1	908.2	1	
26									638.7	697.0	756.3	816.5	877.8	939.9			
27									702.7	766.8	832.0	898.3	965.7				
															Total	208	27

a Regression: $BFV = 0.00078 * (d^2h)^{1.26485}$; increased efficiency = 117 percent; standard error of estimate = 12.7 board feet or 20 percent of the mean volume.

b For example, 9-inch class includes trees 8.6 to 9.5 inches in diameter.

c For example, 60-foot class includes trees 57.6 to 62.5 feet tall.

d Number of trees; range of data for 208 white spruce and 27 black spruce is shaded.

Table 2—Board-foot volume, International rule (1-foot stump to 6-inch top dib) given d.b.h. and total height for paper birch and quaking aspen, Susitna River basin, Alaska[a]

Dbh (d)[b]	Total height in feet (h)[c]												Trees measured[d]	
	25	30	35	40	45	50	55	60	65	70	75	80	Paper birch	Quaking aspen
Inches	Board-foot volume												--Number--	
6	4.0	5.1	6.3	7.5	8.8	10.1	11.5	12.9	14.4	15.9	17.4		1	
7	6.0	7.7	9.5	11.3	13.3	15.3	17.4	19.6	21.8	24.1	26.4		4	1
8	8.6	11.0	13.6	16.2	19.0	21.9	24.9	28.0	31.2	34.4	37.8		14	4
9	11.9	15.1	18.6	22.3	26.1	30.1	34.2	38.4	42.8	47.2	51.8		5	2
10	15.7	20.1	24.7	29.6	34.6	39.9	45.3	51.0	56.8	62.7	68.8	75.0	16	
11	20.3	26.0	31.9	38.2	44.7	51.5	58.6	65.8	73.3	81.0	88.8	96.9	12	2
12	25.7	32.8	40.3	48.2	56.5	65.1	74.0	83.2	92.6	102.3	112.2	122.4	14	3
13		40.7	50.0	59.8	70.1	80.7	91.7	103.1	114.8	126.8	139.1	151.7	7	1
14			61.0	73.0	85.5	98.5	112.0	125.8	140.1	154.8	169.8	185.2	3	
15				87.9	102.9	118.6	134.7	151.4	168.6	186.3	204.4	222.9	4	
16				104.5	122.4	141.0	160.2	180.1	200.6	221.5	243.0	265.0		
17					144.0	165.9	188.6	212.0	236.0	260.7	286.0	311.9	2	
18					167.9	193.5	219.9	247.1	275.2	304.0	333.5	363.7	1	
19					194.2	223.7	254.2	285.8	318.2	351.5	385.6	420.5		
20					222.9	256.7	291.8	328.0	365.2	403.4	442.6	482.6	1	
21								373.9	416.3	459.9	504.5	550.2		
22								423.6	471.7	521.1	571.7	623.4		
											Total		84	13

[a] Regression: BFV = 0.00043 * $(d^2h)^{1.34294}$; increased efficiency = 108 percent; standard error of estimate = 18.2 board feet or 27 percent of the mean volume.

[b] For example, 9-inch class includes trees 8.6 to 9.5 inches in diameter.

[c] For example, 60-foot class includes trees 57.6 to 62.5 feet tall.

[d] Number of trees; range of data for 84 paper birch and 13 quaking aspen is shaded.

Table 3—Board-foot volume, International rule (1-foot stump to 6-inch top dib) given d.b.h. and total height for black cottonwood, Susitna River basin, Alaska[a]

Dbh (d)[b]	Total in feet (h)[c]														Trees measured[d]
	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	Black Cottonwood
Inches	Board-foot volume															--Number--
6	0.6	2.7	4.7	6.7	8.7	10.7	12.7	14.7	16.8	18.8	20.8					
7	7.2	9.9	12.7	15.4	18.2	20.9	23.6	26.4	29.1	31.9	34.6	37.3	40.1			1
8	14.7	18.3	21.9	25.5	29.1	32.6	36.2	39.8	43.4	47.0	50.5	54.1	57.7			4
9	23.3	27.8	32.4	36.9	41.4	46.0	50.5	55.0	59.6	64.1	68.6	73.2	77.7			1
10	32.9	38.5	44.1	49.7	55.2	60.8	66.4	72.0	77.6	83.2	88.8	94.4	100.0			1
11	43.4	50.2	57.0	63.8	70.5	77.3	84.1	90.8	97.6	104.4	111.1	117.9	124.7			7
12	55.0	63.1	71.1	79.2	87.3	95.3	103.4	111.4	119.5	127.5	135.6	143.6	151.7			2
13	67.6	77.1	86.5	96.0	105.4	114.9	124.3	133.8	143.3	152.7	162.2	171.6	181.1	190.5	200.0	
14	81.2	92.2	103.1	114.1	125.1	136.0	147.0	158.0	168.9	179.9	190.9	201.8	212.8	223.8	234.7	3
15	95.8	108.4	121.0	133.6	146.2	158.8	171.3	183.9	196.5	209.1	221.7	234.3	246.9	259.5	272.1	6
16	111.4	125.7	140.1	154.4	168.7	183.0	197.4	211.7	226.0	240.3	254.7	269.0	283.3	297.6	311.9	2
17	128.0	144.2	160.4	176.5	192.7	208.9	225.1	241.2	257.4	273.6	289.7	305.9	322.1	338.2	354.4	4
18				200.0	218.2	236.3	254.4	272.6	290.7	308.8	326.9	345.1	363.2	381.3	399.5	2
19					245.1	265.3	285.5	305.7	325.9	346.1	366.3	386.5	406.7	426.9	447.1	2
20					273.5	295.8	318.2	340.6	363.0	385.4	407.7	430.1	452.5	474.9	497.3	2
21						327.9	352.6	377.3	402.0	426.6	451.3	476.0	500.7	525.3	550.0	1
22						361.6	388.7	415.8	442.9	469.9	497.0	524.1	551.2	578.3	605.3	3
23						396.9	426.5	456.1	485.7	515.3	544.9	574.5	604.1	633.7	663.3	
24						433.7	465.9	498.1	530.4	562.6	594.8	627.1	659.3	691.5	723.7	
25						472.1	507.0	542.0	577.0	611.9	646.9	681.9	716.9	751.8	786.8	1
26						512.0	549.8	587.7	625.5	663.3	701.1	739.0	776.8	814.6	852.4	
27						553.5	594.3	635.1	675.9	716.7	757.5	798.3	839.1	879.8	920.6	
														Total		42

[a] Weighted regression: BFV = -17.48770 + 0.01119 * d^2h; increased efficiency = 103 percent; standard error of estimate = 4.8 board feet or 2 percent of the mean volume.

[b] For example, 9-inch class includes trees 8.6 to 9.5 inches in diameter.

[c] For example, 60-foot class includes trees 57.6 to 62.5 feet tall.

[d] Number of trees; range of data for 42 black cottonwood is shaded.

Table 4—Board-foot volume, International rule (1-foot stump to 6-inch top dib) given d.b.h. and height to a usable top for white spruce and black spruce, Susitna River basin, Alaska[a]

Dbh (d)[b]	Height to a 6-inch top dib in feet (h)[c]															Trees measured[d]	
	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	White spruce	Black spruce
Inches	Board-foot volume															--Number--	
6	3.1	6.0	8.9	11.6	14.4	17.1	19.8									1	1
7	4.2	8.1	11.9	15.6	19.3	23.0	26.6	30.2	33.8							4	2
8	5.4	10.4	15.3	20.1	24.9	29.6	34.3	39.0	43.6							23	8
9	6.7	13.0	19.2	25.2	31.2	37.1	42.9	48.7	54.5	60.3	66.0					40	5
10	8.2	15.9	23.4	30.8	38.1	45.3	52.5	59.6	66.6	73.7	80.7					34	3
11	9.9	19.1	28.1	36.9	45.7	54.3	62.9	71.4	79.9	88.3	96.7	105.0				22	4
12	11.6	22.5	33.1	43.6	53.9	64.1	74.2	84.3	94.3	104.2	114.1	124.0	133.8	143.6	153.3	31	1
13	13.6	26.2	38.6	50.7	62.8	74.6	86.4	98.2	109.8	121.4	132.9	144.4	155.8	167.2	178.5	14	2
14		30.2	44.4	58.4	72.3	86.0	99.5	113.0	126.4	139.8	153.0	166.2	179.4	192.5	205.6	14	1
15			50.7	66.6	82.4	98.0	113.5	128.9	144.2	159.4	174.5	189.6	204.6	219.5	234.4	8	
16			57.3	75.3	93.2	110.8	128.3	145.7	163.0	180.2	197.3	214.4	231.3	248.2	265.1	8	
17			64.3	84.6	104.6	124.4	144.0	163.6	183.0	202.2	221.5	240.6	259.6	278.6	297.5	4	
18			71.7	94.3	116.6	138.7	160.6	182.3	204.0	225.5	246.9	268.2	289.5	310.6	331.7	4	
19						153.7	178.0	202.1	226.1	249.9	273.7	297.3	320.8	344.3	367.6		
20							196.2	222.8	249.3	275.6	301.7	327.8	353.7	379.6	405.3		
21									273.5	302.4	331.1	359.7	388.2	416.5	444.8		
22										330.4	361.8	393.0	424.1	455.1	486.0		
23										359.6	393.7	427.7	461.5	495.3	528.9		
24										389.9	426.9	463.8	500.5	537.0	573.5		
25										421.4	461.4	501.2	540.9	580.4	619.8	1	
26										454.1	497.2	540.1	582.8	625.4	667.9		
27										487.9	534.2	580.3	626.2	672.0	717.6		
														Total		208	27

[a] Regression: BFV = 0.02223 * $(d^2h)^{0.95170}$; increased efficiency = 123 percent; standard error of estimate = 10.0 board feet or 16 percent of the mean volume.

[b] For example, 9-inch class includes trees 8.6 to 9.5 inches in diameter.

[c] For example, 60-foot class includes trees 57.6 to 62.5 feet tall.

[d] Number of trees; range of data for 208 white spruce and 27 black spruce is shaded.

Table 5—Board-foot volume, International rule (1-foot stump to 6-inch top dib) given d.b.h. and height to a usable top for paper birch and quaking aspen, Susitna River basin, Alaska[a]

Dbh (d)[b]	Height to a 6-inch top dib in feet (h)[c]													Trees measured[d]	
	5	10	15	20	25	30	35	40	45	50	55	60	65	Paper birch	Quaking aspen
Inches	Board-foot volume													--Number--	
6	3.6	6.9	10.1	13.2	16.3	19.3	22.3	25.2						1	
7	4.9	9.2	13.5	17.6	21.7	25.7	29.7	33.6	37.5	41.3	45.1	49.0		4	1
8	6.2	11.9	17.3	22.6	27.8	32.9	38.0	43.0	48.0	53.0	57.9	62.8		14	4
9	7.7	14.8	21.5	28.1	34.6	41.0	47.3	53.6	59.8	65.9	72.1	78.1		5	2
10	9.4	18.0	26.2	34.2	42.1	49.9	57.6	65.2	72.7	80.2	87.7	95.0	102.4	16	
11	11.3	21.4	31.3	40.8	50.3	59.6	68.7	77.8	86.8	95.8	104.7	113.5	122.2	12	2
12	13.2	25.2	36.7	48.0	59.1	70.0	80.8	91.5	102.1	112.6	123.0	133.4	143.7	14	3
13	15.4	29.3	42.6	55.7	68.6	81.3	93.8	106.2	118.5	130.7	142.8	154.8	166.8	7	1
14	17.6	33.6	49.0	64.0	78.7	93.3	107.7	121.9	136.0	150.0	163.9	177.7	191.4	3	
15				72.7	89.5	106.0	122.4	138.6	154.6	170.5	186.3	202.1	217.7	4	
16					100.9	119.6	138.0	156.3	174.3	192.3	210.1	227.8	245.4		
17					113.0	133.8	154.5	174.9	195.2	215.2	235.2	255.0	274.7	2	
18					125.6	148.9	171.8	194.5	217.0	239.4	261.6	283.6	305.5	1	
19					138.9	164.6	190.0	215.1	240.0	264.7	289.3	313.6	337.9		
20					152.8	181.1	209.0	236.6	264.0	291.2	318.2	345.0	371.7	1	
21								259.1	289.1	318.9	348.4	377.8	407.0		
22								282.5	315.2	347.7	379.9	412.0	443.8		
												Total		84	13

[a] Regression: $BFV = 0.02911 * (d^2h)^{0.93005}$; increased efficiency = 114 percent; standard error of estimate = 11.9 board feet or 18 percent of the mean volume.

[b] For example, 9-inch class includes trees 8.6 to 9.5 inches in diameter.

[c] For example, 60-foot class includes trees 57.6 to 62.5 feet tall.

[d] Number of trees; range of data for 84 paper birch and 13 quaking aspen is shaded.

Table 6—Board-foot volume, International rule (1-foot stump to 6-inch top dib) given d.b.h. and height to a usable top for black cottonwood, Susitna River basin, Alaska[a]

Dbh (d)[b]	Height to a 6-inch top dib in feet (h)[c]																	Trees measured[d]
	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	Black Cottonwood
Inches	Board-foot volume																	--Number--
6	9.1	11.6	14.1	16.7	19.2	21.7	24.3	26.8										
7	11.8	15.3	18.7	22.1	25.6	29.0	32.5	35.9	39.4	42.8								1
8	15.0	19.5	24.0	28.5	33.0	37.5	42.0	46.4	50.9	55.4								4
9	18.6	24.3	29.9	35.6	41.3	47.0	52.7	58.4	64.1	69.8	75.5	81.2						1
10	22.6	29.6	36.6	43.6	50.7	57.7	64.7	71.7	78.8	85.8	92.8	99.8						1
11	27.0	35.5	44.0	52.5	61.0	69.5	78.0	86.5	95.0	103.5	112.0	120.5						7
12	31.8	42.0	52.1	62.2	72.3	82.4	92.5	102.6	112.8	122.9	133.0	143.1	153.2	163.3	173.5			2
13	37.1	49.0	60.9	72.7	84.6	96.5	108.3	120.2	132.1	144.0	155.8	167.7	179.6	191.4	203.3	215.2	227.1	
14	42.8	56.6	70.3	84.1	97.9	111.6	125.4	139.2	152.9	166.7	180.5	194.3	208.0	221.8	235.6	249.3	263.1	3
15		64.7	80.5	96.3	112.1	127.9	143.7	159.6	175.4	191.2	207.0	222.8	238.6	254.4	270.2	286.0	301.8	6
16		73.4	91.4	109.4	127.4	145.4	163.3	181.3	199.3	217.3	235.3	253.3	271.2	289.2	307.2	325.2	343.2	2
17		82.7	103.0	123.3	143.6	163.9	184.2	204.5	224.8	245.1	265.4	285.7	306.0	326.3	346.6	366.9	387.2	4
18						183.6	206.3	229.1	251.9	274.6	297.4	320.1	342.9	365.7	388.4	411.2	433.9	2
19						204.4	229.7	255.1	280.5	305.8	331.2	356.5	381.9	407.3	432.6	458.0	483.3	2
20							254.4	282.5	310.6	338.7	366.8	394.9	423.0	451.1	479.2	507.3	535.4	2
21								311.3	342.3	373.3	404.2	435.2	466.2	497.2	528.2	559.1	590.1	1
22								341.5	375.5	409.5	443.5	477.5	511.5	545.5	579.5	613.5	647.5	3
23								373.1	410.3	447.4	484.6	521.8	558.9	596.1	633.2	670.4	707.6	
24								406.1	446.6	487.1	527.5	568.0	608.4	648.9	689.4	729.8	770.3	
25								440.6	484.5	528.4	572.3	616.2	660.1	704.0	747.9	791.8	835.7	1
26								476.4	523.9	571.4	618.8	666.3	713.8	761.3	808.8	856.3	903.8	
27								513.6	564.8	616.0	667.2	718.5	769.7	820.9	872.1	923.3	974.5	
																Total		42

[a] Weighted regression: $BFV = 1.48958 + 0.01405 * d^2h$; increased efficiency = 106 percent; standard error of estimate = 5.4 board feet or 2 percent of the mean volume.

[b] For example, 9-inch class includes trees 8.6 to 9.5 inches in diameter.

[c] For example, 60-foot class includes trees 57.6 to 62.5 feet tall.

[d] Number of trees; range of data for 42 black cottonwood is shaded.

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