REGIONAL BIOMASS EQUATIONS USED BY FIA TO ESTIMATE BOLE, BARK, AND BRANCHES

BIOMASS OF THE TREE STEM

Tree stem biomass, regardless of whether it is merchantable bole or total stem, is calculated from cubic volume estimates and the wood density factor (in tables below) as follows:

Cubic volume = green cubic volume in cubic feet (ft3)
Wood density = (Specific gravity of a tree species) * (62.4 lbs/ft3)

Weight of water = 62.4 pounds/cubic foot

Biomass of the tree stem (in tons**) =** (cubic foot volume * wood density) / 2000

The tables below contain specific gravity and wood density values for many species.

Softwoods

Code	Species	Specific gravity	Wood density
11	Pacific silver fir	0.4	24.96
14	Bristlecone fir	0.36	22.46
15	White fir	0.37	23.09
17	Grand fir	0.35	21.84
19	Subalpine fir	0.31	19.34
20	California red fir	0.36	22.46
21	Shasta red fir	0.36	22.46
22	Noble fir	0.37	23.09
41	Port-Orford-cedar	0.39	24.34
42	Alaska-cedar	0.42	26.21
50	Cypress	0.67	41.81
56	McNabb cypress	.67	41.81
62	California juniper	0.54	33.7
64	Western juniper	0.54	33.7
65	Utah juniper	0.54	33.7
72	Subablpine larch	0.48	29.95
73	Western larch	0.48	29.95
81	Incense cedar	0.35	21.84
92	Brewer spruce	0.35	21.84
93	Engelmann spruce	0.33	20.59
98	Sitka spruce	0.37	23.09
101	Whitebark pine	0.37	23.09
102	Bristlecone pine	0.37	23.09
103	Knobcone pine	0.37	23.09
104	Foxtail pine	0.37	23.09
108	Lodgepole pine	0.38	23.71
109	Coulter pine	0.43	26.83
113	Limber pine	0.37	23.09
116	Jeffrey pine	0.38	23.71
117	Sugar pine	0.34	21.22
119	Western white pine	0.35	21.84
120	Bishop pine	0.43	26.83
122	Ponderosa pine	0.38	23.71
124	Monterey pine	0.35	21.84
127	Gray pine	0.43	26.83
133	Singleleaf pinyon	0.37	23.09
137	Washoe pine	.37	23.09
201	Bigcone Douglas-fir	0.46	28.7
202	Douglas-fir	0.46	28.7
211	Redwood	0.34	21.22
212	Giant Sequoia	0.38	23.71
231	Pacific yew	0.67	41.81
242	Western redcedar	0.31	19.34
251	California nutmeg	0.51	31.82
263	Western hemlock	0.42	26.21
264	Mountain hemlock	0.42	26.21
298	Unknown softwood	0.41	25.58

Hardwoods

Code	Species	Specific gravity	Wood density
312	Bigleaf maple	0.44	27.46
313	Boxelder		19.34
330	California buckeye	0.38	23.71
341	Tree of heaven	0.3	18.72
351	Red alder	0.37	23.09
352	White alder	0.37	23.09
361	Pacific madrone	0.69	43.06
374	Water birch	0.3	18.72
376	Western paper birch	0.3	18.72
431	Golden chinkapin	0.48	29.95
475	Curlleaf mountain-mahogany		
492	Pacific dogwood	0.7	43.68
510	Eucalyptus	0.8	49.92
542	Oregon ash	0.5	31.2
590	Holly		37.44
600	Walnut	0.51	31.82
631	Tanoak	0.58	36.19
660	Apple	0.58	36.19
730	California sycamore	0.46	28.7
740	Cottonwood and poplar		
746	Quaking aspen	0.35	21.84
747	Black cottonwood	0.31	19.34
748	Fremont poplar	0.31	19.34
760	Cherry		29.32
801	California live oak	0.8	49.92
805	Canyon live oak	0.8	49.92
807	Blue oak	0.6	37.44
811	Englemann oak	0.6	37.44
815	Oregon white oak	0.6	37.44
818	California black oak	0.56	34.94
821	California white oak	0.6	37.44
839	Interior live oak	0.8	49.92
920	Willow	0.36	22.46
981	California-laurel	0.59	36.82
998	Unknown hardwood	0.51	31.82
999	Unknown tree	0.45	28.08

SOFTWOOD BIOMASS EQUATION ASSIGNMENTS

BIOMASS OF BARK

Code	Species	Halfstate				
		WOR	WWA	EOR	EWA	CA
11	Pacific silver fir	22	22	22	22	--
14	Bristlecone fir	--	--	--	--	2
15	White fir	1	1	1	1	1
17	Grand fir	2	2	2	2	2
18	Corkbark fir	--	--	--	--	0
19	Subalpine fir	3	3	3	3	3
20	California red fir	--	--	--	--	4
21	Shasta red fir	4	4	4	4	4
22	Noble fir	5	5	5	5	5
41	Port-Orford-cedar	13	13	13	13	13
42	Alaska-cedar	23	23	23	23	13
50	Cypress	--	--	--	--	13
51	Arizona cypress	--	--	--	--	0
56	Mcnabb cypress	--	--	--	--	13
58	Pinchot juniper	--	--	--	--	0
59	Redberry juniper	--	--	--	--	0
62	California juniper	--	--	--	--	16
63	Alligator juniper	--	--	--	--	0
64	Western juniper	16	16	16	16	16
65	Utah juniper	--	--	--	--	16
66	Rocky Mountain juniper	--	--	--	--	0
69	Oneseed juniper	--	--	--	--	0
72	Subablpine larch	24	24	24	24	--
73	Western larch	24	24	24	24	--
81	Incense cedar	12	12	12	12	12
92	Brewer spruce	7	7	7	7	7
93	Engelmann spruce	7	7	7	7	7
94	White spruce	--	--	--	--	0
96	Blue spruce	--	--	--	--	0
98	Sitka spruce	6	6	6	6	6
101	Whitebark pine	11	11	11	11	14
102	Bristlecone pine	--	--	--	--	14
103	Knobcone pine	14	14	14	14	14
104	Foxtail pine	--	--	--	--	14
106	Twoneedle pinyon	--	--	--	--	0
108	Lodgepole pine	14	14	14	14	14
109	Coulter pine	--	--	--	--	9
112	Apache pine	--	--	--	--	0
113	Limber pine	--	--	--	--	14
114	Southwestern white pine	--	--	--	--	0
116	Jeffrey pine	9	9	9	9	9

SOFTWOOD BIOMASS EQUATION ASSIGNMENTS
--continued--
BIOMASS OF BARK

		Halfstate				
Code	Species	WOR	WWA	EOR	EWA	CA
117	Sugar pine	10	10	10	10	10
118	Chihuahuan pine	--	--	--	--	0
119	Western white pine	11	11	11	11	11
120	Bishop pine	--	--	--	--	14
122	Ponderosa pine	9	9	9	9	9
124	Monterey pine	--	--	--	--	14
127	Gray pine	--	--	--	--	9
130	Scotch pine	0	0	0	0	0
133	Singleleaf pinyon	--	--	--	--	14
134	Border pinyon	--	--	--	--	0
135	Arizona pine	--	--	--	--	0
137	Washoe pine	--	--	--	--	9
201	Bigcone Douglas-fir	--	--	--	--	8
202	Douglas-fir	8	8	25	25	8
211	Redwood	17	17	17	17	17
212	Giant Sequoia	17	17	17	17	17
231	Pacific yew	13	13	13	13	13
242	Western redcedar	13	13	13	13	13
251	California nutmeg	--	--	--	--	13
263	Western hemlock	26	26	26	26	15
264	Mountain hemlock	21	21	21	21	21
298	Unknown Conifer	21	21	21	21	21

SOFTWOOD BIOMASS EQUATION ASSIGNMENTS

BIOMASS OF LIVE BRANCHES

Code	Species	Halfstate				
		WOR	WWA	EOR	EWA	CA
11	Pacific silver fir	18	18	18	18	--
14	Bristlecone fir	--	--	--	--	1
15	White fir	1	1	1	1	1
17	Grand fir	1	1	1	1	1
18	Corkbark fir	--	--	--	--	0
19	Subalpine fir	2	2	2	2	2
20	California red fir	--	--	--	--	3
21	Shasta red fir	3	3	3	3	3
22	Noble fir	3	3	3	3	3
41	Port-Orford-cedar	10	10	10	10	10
42	Alaska-cedar	19	19	19	19	10
50	Cypress	--	--	--	--	10
51	Arizona cypress	--	--	--	--	0
56	Mcnabb cypress	--	--	--	--	10
58	Pinchot juniper	--	--	--	--	0
59	Redberry juniper	--	--	--	--	0
62	California juniper	--	--	--	--	13
63	Alligator juniper	--	--	--	--	0
64	Western juniper	13	13	13	13	13
65	Utah juniper	--	--	--	--	13
66	Rocky Mountain juniper	--	--	--	--	0
69	Oneseed juniper	--	--	--	--	0
72	Subablpine larch	20	20	20	20	--
73	Western larch	20	20	20	20	--
81	Incense cedar	10	10	10	10	10
92	Brewer spruce	4	4	4	4	4
93	Engelmann spruce	4	4	4	4	4
94	White spruce	--	--	--	--	0
96	Blue spruce	--	--	--	--	0
98	Sitka spruce	5	5	5	5	5
101	Whitebark pine	9	9	9	9	11
102	Bristlecone pine	--	--	--	--	11
103	Knobcone pine	11	11	11	11	11
104	Foxtail pine	--	--	--	--	11
106	Twoneedle pinyon	--	--	--	--	0
108	Lodgepole pine	11	11	11	11	11
109	Coulter pine	--	--	--	--	7
112	Apache pine	--	--	--	--	0
113	Limber pine	--	--	--	--	11
114	Southwestern white pine	--	--	--	--	0
116	Jeffrey pine	7	7	7	7	7
117	Sugar pine	8	8	8	8	8
118	Chihuahuan pine	--	--	--	--	0

SOFTWOOD BIOMASS EQUATION ASSIGNMENTS
--continued--
BIOMASS OF LIVE BRANCHES

Code	Species	Halfstate				
		WOR	WWA	EOR	EWA	CA
119	Western white pine	9	9	9	9	9
120	Bishop pine	--	--	--	--	11
122	Ponderosa pine	7	7	7	7	7
124	Monterey pine	--	--	--	--	11
127	Gray pine	--	--	--	--	7
130	Scotch pine	--	--	--	--	0
133	Singleleaf pinyon	--	--	--	--	11
134	Border pinyon	--	--	--	--	0
135	Arizona pine	--	--	--	--	0
137	Washoe pine	--	--	--	--	7
201	Bigcone Douglas-fir	--	--	--	--	6
202	Douglas-fir	6	6	22	22	6
211	Redwood	10	10	10	10	10
212	Giant Sequoia	10	10	10	10	10
231	Pacific yew	10	10	10	10	10
242	Western redcedar	10	10	10	10	10
251	California nutmeg	--	--	--	--	10
263	Western hemlock	23	23	23	23	12
264	Mountain hemlock	24	24	24	24	17
298	Unknown Conifer	24	24	24	24	17

HARDWOOD BIOMASS EQUATION ASSIGNMENTS

BIOMASS OF BARK

Code	Species	Halfstate				
		WOR	WWA	EOR	EWA	CA
300	Acacia	--	--	--	--	0
312	Bigleaf maple	29	29	29	29	--
313	Boxelder	--	--	--	--	--
321	Rocky Mountain maple	--	--	--	--	0
322	Bigtooth maple	--	--	--	--	0
330	California buckeye	--	--	--	--	0
341	Tree of heaven	20	20	20	20	20
351	Red alder	20	20	20	20	20
352	White alder	20	20	20	20	20
361	Pacific madrone	34	34	34	34	--
374	Water birch	20	20	20	20	20
375	Paper birch	--	--	--	--	0
376	Western paper birch	--	--	--	--	0
431	Golden chinkapin	32	32	32	32	--
475	Curlleaf mountain-mahogany	--	--	--	--	0
476	True mountain-mahogany	--	--	--	--	0
477	Hairy mountain-mahogany	--	--	--	--	0
478	Birchleaf mountain-mahogany	--	--	--	--	0
479	Littleleaf mountain-mahogany	--	--	--	--	0
492	Pacific dogwood	29	--	29	29	--
500	Hawthorn	--	--	--	--	0
510	Eucalyptus	--	--	--	--	0
542	Oregon ash	20	20	20	20	--
590	Holly	27	27	27	27	--
600	Walnut	30	30	30	30	--
631	Tanoak	36	36	36	36	--
660	Apple	31	31	31	31	--
730	California sycamore	--	--	--	--	0
740	Cottonwood and poplar	--	--	--	--	0
741	Balsam poplar	--	--	--	--	0
742	Eastern cottonwood	--	--	--	--	0
745	Plains cottonwood	--	--	--	--	0
746	Quaking aspen	18	18	18	18	18
747	Black cottonwood	28	28	28	28	18
748	Fremont poplar	18	18	18	18	18
755	Mesquite	--	--	--	--	0
760	Cherry	27	27	27	27	--
800	Oak-deciduous	--	--	--	--	0
801	California live oak	--	--	--	--	0
805	Canyon live oak	31	31	31	31	31

Code	Species	Halfstate				
		WOR	WWA	EOR	EWA	CA
807	Blue oak	--	--	--	--	0
810	Emory oak	--	--	--	--	0
811	Englemann oak	--	--	--	--	0
814	Gambel oak	--	--	--	--	0
815	Oregon white oak	35	35	35	35	--
818	California black oak	30	30	30	30	--
821	California white oak	--	--	--	--	0
829	Mexican blue oak	--	--	--	--	0
839	Interior live oak	--	--	--	--	0
843	Silverleaf oak	--	--	--	--	0
850	Oak-evergreen	--	--	--	--	0
901	Black locust	--	--	--	--	0
902	New Mexico locust	--	--	--	--	0
920	Willow	34	34	34	34	--
981	California-laurel	33	33	33	33	--
990	Tesota (Arizona ironwood)	--	--	--	--	0
998	Unknown hardwood	20	20	20	20	20
999	Unknown Tree	35	35	35	35	0

HARDWOOD BIOMASS EQUATION ASSIGNMENTS

BIOMASS OF LIVE BRANCHES

Code	Species	WOR	WWA	Halfstate EOR	EWA	CA
300	Acacia	--	--	--	--	0
312	Bigleaf maple	--	--	--	--	--
313	Boxelder	--	--	--	--	0
321	Rocky Mountain maple	--	--	--	--	0
322	Bigtooth maple	--	--	--	--	0
330	California buckeye	--	--	--	--	0
341	Tree of heaven	14	14	14	14	14
351	Red alder	16	16	16	16	16
352	White alder	16	16	16	16	16
361	Pacific madrone	--	--	--	--	--
374	Water birch	14	14	14	14	14
375	Paper birch	--	--	--	--	0
376	Western paper birch	25	25	25	25	3
431	Golden chinkapin	--	--	--	--	--
475	Curlleaf mountain-mahogany	--	--	--	--	0
476	True mountain-mahogany	--	--	--	--	0
477	Hairy mountain-mahogany	--	--	--	--	0
478	Birchleaf mountain-mahogany	--	--	--	--	0
479	Littleleaf mountain-mahogany	--	--	--	--	0
492	Pacific dogwood	--	--	--	--	--
500	Hawthorn	--	--	--	--	0
510	Eucalyptus	--	--	--	--	0
542	Oregon ash	--	--	--	--	--
590	Holly	25	25	25	25	0
600	Walnut	--	--	--	--	--
631	Tanoak	--	--	--	--	--
660	Apple	--	--	--	--	0
730	California sycamore	--	--	--	--	0
740	Cottonwood and poplar	--	--	--	--	0
741	Balsam poplar	--	--	--	--	0
742	Eastern cottonwood	--	--	--	--	0
745	Plains cottonwood	--	--	--	--	0
746	Quaking aspen	14	14	14	14	14
747	Black cottonwood	15	15	15	15	15
748	Fremont poplar	5	5	5	5	5
755	Mesquite	--	--	--	--	0
760	Cherry	25	25	25	25	0
800	Oak-deciduous	--	--	--	--	0
801	California live oak	--	--	--	--	--
805	Canyon live oak	--	--	--	--	--
807	Blue oak	--	--	--	--	--
810	Emory oak	0	0	0	0	0
811	Englemann oak	0	0	0	0	0

Code	Species	WOR	WWA	Halfstate EOR	EWA	CA
814	Gambel oak	--	--	--	--	0
815	Oregon white oak	--	--	--	--	--
818	California black oak	--	--	--	--	--
821	California white oak	--	--	--	--	--
829	Mexican blue oak	--	--	--	--	0
839	Interior live oak	--	--	--	--	--
843	Silverleaf oak	--	--	--	--	0
850	Oak-evergreen	--	--	--	--	0
901	Black locust	--	--	--	--	0
902	New Mexico locust	--	--	--	--	0
920	Willow	--	--	--	--	--
981	California-laurel	--	--	--	--	--
990	Tesota (Arizona ironwood)	--	--	--	--	--
998	Unknown hardwood	16	16	16	16	16
999	Unknown Tree	16	16	16	16	16

SPECIES 312, 330, 361, 431, 492, 600, 631, 801, 805, 807, 811, 815, 818, 821, 839, 920, and 981 hardwood volumes are calculated with Pillsbury equations; this means that total stem volume includes branches and bark, thus bark biomass and live branch biomass are not available as separate components of biomass.

BIOMASS OF BARK

All equations produce Biomass of Bark in Kilograms --- to convert to tons multiply by 0.0011023

Log in the equations is = NATURAL LOG

EQUATION 1 BIOPAK EQUATION 379

$$\mathrm{BB} = \frac{\exp(2.1069 + 2.7271 \times \log(DBH))}{1000}$$

EQUATION 2 BIOPAK EQUATION 887

$$\mathrm{BB} = 0.6 + 16.4 \times \left(\frac{DBH}{100}\right)^2 \times HT$$

EQUATION 3 BIOPAK EQUATION 917

$$\mathrm{BB} = 1.0 + 17.2 \times \left(\frac{DBH}{100}\right)^2 \times HT$$

EQUATION 4 BIOPAK EQUATION 382

$$\mathrm{BB} = \frac{\exp(1.47146 + 2.8421 \times \log(DBH))}{1000}$$

EQUATION 5 BIOPAK EQUATION 251

$$\mathrm{BB} = \frac{\exp(2.79189 + 2.4313 \times \log(DBH))}{1000}$$

EQUATION 6 BIOPAK EQUATION 845

$$\mathrm{BB} = 1.3 + 12.6 \times \left(\frac{DBH}{100}\right)^2 \times HT$$

EQUATION 7 BIOPAK EQUATION 875

$$\mathrm{BB} = 4.5 + 9.3 \times \left(\frac{DBH}{100}\right)^2 \times HT$$

EQUATION 8 BIOPAK EQUATION 5

$$\mathrm{BB} = \exp(-4.3103 + 2.4300 \times \log(DBH))$$

EQUATION 9 BIOPAK EQUATION 705

$$\mathrm{BB} = \exp(-3.6263 + 1.34077 \times \log(DBH) + 0.8567 \times \log(HT))$$

EQUATION 10 BIOPAK EQUATION 391

$$\mathrm{BB} = \frac{\exp(2.183174 + 2.6610 \times \log(DBH))}{1000}$$

EQUATION 11 BIOPAK EQUATION 899

$$\mathrm{BB} = 1.2 + 11.2 \times \left(\frac{DBH}{100}\right)^2 \times HT$$

EQUATION 12 (updated) BIOPAK EQUATION 385

$$\mathrm{BB} = \frac{\exp(-13.3146 + 2.8594 \times \log(DBH)) * 1000}{}$$

EQUATION 13 BIOPAK EQUATION 461

$$\mathrm{BB} = 0.336 + 0.00058 \times DBH^2 \times HT$$

EQUATION 14 BIOPAK EQUATION 904

$$\mathrm{BB} = 3.2 + 9.1 \times \left(\frac{DBH}{100}\right)^2 \times HT$$

EQUATION 15

$$\mathrm{BB} = \exp(-4.371 + 2.259 \times \log(DBH))$$

EQUATION 16 BIOPAK EQUATION 54

$$\mathrm{BB} = \exp(-10.175 + 2.6333 \times \log(DBH \times \pi))$$

EQUATION 17 BIOPAK EQUATION 394

$$\mathrm{BB} = \frac{\exp(7.189689 + 1.5837 \times \log(DBH))}{1000}$$

EQUATION 18 BIOPAK EQUATION 942

$$\mathrm{BB} = 1.3 + 27.6 \times \left(\frac{DBH}{100}\right)^2 \times HT$$

EQUATION 19

$$\mathrm{BB} = 0.0$$

EQUATION 20 BIOPAK EQUATION 275

$$\mathrm{BB} = \exp(-4.6424 + 2.4617 \times \log(DBH))$$

EQUATION 21 BIOPAK EQUATION 911

$$\mathrm{BB} = 0.9 + 27.4 \times \left(\frac{DBH}{100}\right)^2 \times HT$$

EQUATION 22 BIOPAK EQUATION 881

$$\mathrm{BB} = 1.0 + 15.6 \times \left(\frac{DBH}{100}\right)^2 \times HT$$

EQUATION 23 BIOPAK EQUATION 923

$$\mathrm{BB} = 1.8 + 9.6 \times \left(\frac{DBH}{100}\right)^2 \times HT$$

EQUATION 24 BIOPAK EQUATION 893

$$\mathrm{BB} = 2.4 + 15.0 \times \left(\frac{DBH}{100}\right)^2 \times HT$$

EQUATION 25 BIOPAK EQUATION 857

$$\mathrm{BB} = 3.6 + 18.2 \times \left(\frac{DBH}{100}\right)^2 \times HT$$

EQUATION 26 Weyerhaeuser Co Equation

$$\mathrm{BB} = -0.025 + 0.00134 \times DBH^2 \times HT$$

EQUATION 27

$$\mathrm{BB} = -1.2 + 29.1 \times \left(\frac{DBH}{100}\right)^2 \times HT$$

EQUATION 28 BIOPAK EQUATION 930

$$\mathrm{BB} = 1.2 + 15.5 \times \left(\frac{DBH}{100}\right)^2 \times HT$$

EQUATION 29 (Bigleaf maple)

$$ADBH = \frac{(DBH - 0.21235)}{0.94782} \quad (1)$$

$$OUTERVOL = 0.0000246916 \times \left(ADBH^{2.354347}\left(HT^{0.69586}\right)\right) \quad (2)$$

$$INNERVOL = 0.0000246916 \times \left(DBH^{2.354347}\left(HT^{0.69586}\right)\right) \quad (3)$$

$$BB = (OUTERVOL - INNERVOL) \times 35.30 \times DENSFAC / 2.2046 \quad (4)$$

EQUATION 30 (California Black Oak)

$$ADBH = \frac{(DBH + 0.68133)}{0.95767} \quad 1$$

$$OUTERVOL = 0.0000386403 \times \left(ADBH^{2.12635}\left(HT^{0.83339}\right)\right) \quad 2$$

$$INNERVOL = 0.0000386403 \times \left(DBH^{2.12635}\left(HT^{0.83339}\right)\right) \quad 3$$

$$BB = (OUTERVOL - INNERVOL) \times 35.30 \times DENSFAC / 2.2046 \quad 4$$

EQUATION 31 (Canyon Live Oak)

$$ADBH = \frac{(DBH + 0.48584)}{0.96147} \quad 1$$

$$OUTERVOL = 0.0000248325 \times \left(ADBH^{2.32519}\left(HT^{0.74348}\right)\right) \quad 2$$

$$INNERVOL = 0.0000248325 \times \left(DBH^{2.32519}\left(HT^{0.74348}\right)\right) \quad 3$$

$$BB = (OUTERVOL - INNERVOL) \times 35.30 \times DENSFAC / 2.2046 \quad 4$$

EQUATION 32 (Golden Chinkapin)

$$ADBH = \frac{(DBH - 0.39534)}{0.90182} \quad 1$$

$$OUTERVOL = 0.000056884 \times \left(ADBH^{2.07202}\left(HT^{0.77467}\right)\right) \quad 2$$

$$INNERVOL = 0.000056884 \times \left(DBH^{2.07202}\left(HT^{0.77467}\right)\right) \quad 3$$

$$BB = (OUTERVOL - INNERVOL) \times 35.30 \times DENSFAC / 2.2046 \quad 4$$

EQUATION 33 (California Laurel)

$$ADBH = \frac{(DBH + 0.32491)}{0.96579} \quad 1$$

$$OUTERVOL = 0.0000237733 \times \left(ADBH^{2.05910}\left(HT^{1.05293}\right)\right) \quad 2$$

$$INNERVOL = 0.0000237733 \times \left(DBH^{2.05910}\left(HT^{1.05293}\right)\right) \quad 3$$

$$BB = (OUTERVOL - INNERVOL) \times 35.30 \times DENSFAC / 2.2046 \quad 4$$

EQUATION 34 **(Pacific Madrone)**

$$ADBH = \frac{(DBH + 0.03425)}{0.98155} \quad 1$$

$$OUTERVOL = 0.0000378129 \times (ADBH^{1.99295}(HT^{1.01532})) \quad 2$$

$$INNERVOL = 0.0000378129 \times (DBH^{1.99295}(HT^{1.01532})) \quad 3$$

$$BB = (OUTERVOL - INNERVOL) \times 35.30 \times DENSFAC / 2.2046 \quad 4$$

EQUATION 35 **(Oregon White Oak)**

$$ADBH = \frac{(DBH + 0.78034)}{0.95956} \quad 1$$

$$OUTERVOL = 0.0000236325 \times (ADBH^{2.25575}(HT^{0.87108})) \quad 2$$

$$INNERVOL = 0.0000236325 \times (DBH^{2.25575}(HT^{0.87108})) \quad 3$$

$$BB = (OUTERVOL - INNERVOL) \times 35.30 \times DENSFAC / 2.2046 \quad 4$$

EQUATION 36 **(Tanoak)**

$$ADBH = \frac{(DBH + 4.1177)}{0.95354} \quad 1$$

$$OUTERVOL = 0.0000081905 \times (ADBH^{2.19576}(HT^{1.14078})) \quad 2$$

$$INNERVOL = 0.0000081905 \times (DBH^{2.19576}(HT^{1.14078})) \quad 3$$

$$BB = (OUTERVOL - INNERVOL) \times 35.30 \times DENSFAC / 2.2046 \quad 4$$

WHERE

Log	= NATURAL LOG
DBH	= DIAMETER OF TREE IN CENTIMETERS
HT	= HEIGHT OF TREE IN METERS
DENSFAC	= DENSITY FACTOR FOR SPECIES
BB	= BIOMASS OF BARK, WEIGHT IN KILOGRAMS, OF THE BARK ON THE TREE BOLE
π	= 3.141593

BIOMASS OF LIVE BRANCHES

All equations produce Biomass of Live Branches in Kilograms --- to convert to tons multiply by 0.0011023

Log in the equations is = NATURAL LOG

Log = natural log

EQUATION 1 BIOPAK EQUATION 889

$$\mathrm{BLB} = 13.0 + 12.4 \times \left(\frac{DBH}{100}\right)^2 \times HT$$

EQUATION 2 BIOPAK EQUATION 919

$$\mathrm{BLB} = 3.6 + 44.2 \times \left(\frac{DBH}{100}\right)^2 \times HT$$

EQUATION 3 BIOPAK EQUATION 28

$$\mathrm{BLB} = \exp\left(-4.1817 + 2.3324 \times \log\left(DBH\right)\right)$$

EQUATION 4 BIOPAK EQUATION 877

$$\mathrm{BLB} = 16.8 + 14.4 \times \left(\frac{DBH}{100}\right)^2 \times HT$$

EQUATION 5 BIOPAK EQUATION 847

$$\mathrm{BLB} = 9.7 + 22.0 \times \left(\frac{DBH}{100}\right)^2 \times HT$$

EQUATION 6 BIOPAK EQUATION 2

$$\mathrm{BLB} = \exp\left(-3.6941 + 2.1382 \times \log\left(DBH\right)\right)$$

EQUATION 7 BIOPAK EQUATION 702

$$\mathrm{BLB} = \exp\left(-4.1068 + 1.5177 \times \log\left(DBH\right) + 1.0424 \times \log\left(HT\right)\right)$$

EQUATION 8

$$\mathrm{BLB} = \exp\left(-7.637 + 3.3648 \times \log\left(DBH\right)\right)$$

EQUATION 9 BIOPAK EQUATION 901

$$\mathrm{BLB} = 9.5 + 16.8 \times \left(\frac{DBH}{100}\right)^2 \times HT$$

EQUATION 10 BIOPAK EQUATION 459

$$\mathrm{BLB} = 0.199 + 0.00381 \times DBH^2 \times HT$$

EQUATION 11 BIOPAK EQUATION 907

$$\mathrm{BLB} = 7.8 + 12.3 \times \left(\frac{DBH}{100}\right)^2 \times HT$$

EQUATION 12

$$\mathrm{BLB} = \exp\left(-4.570 + 2.271 \times \log\left(DBH\right)\right)$$

EQUATION 13 BIOPAK EQUATION 51

$$\mathrm{BLB} = \exp\left(-7.2775 + 2.3337 \times \log\left(DBH \times \pi\right)\right)$$

EQUATION 14 BIOPAK EQUATION 944

$$\mathrm{BLB} = 1.7 + 26.2 \times \left(\frac{DBH}{100}\right)^2 \times HT$$

EQUATION 15 BIOPAK EQUATION 932

$$\mathrm{BLB} = 2.5 + 36.8 \times \left(\frac{DBH}{100}\right)^2 \times HT$$

EQUATION 16

$$\mathrm{BLB} = \exp\left(-4.5648 + 2.6232 \times \log\left(DBH\right)\right) - BF$$

where: $$\mathrm{BF} = \left(\exp\left(-4.5648 + 2.6232 \times \log\left(DBH\right)\right)\right) \times \frac{1}{(2.7638 + 0.062 \times DBH^{1.3364}}$$

EQUATION 17

$$\mathrm{BLB} = \exp\left(-5.2581 + 2.6045 \times \log\left(DBH\right)\right)$$

EQUATION 18 BIOPAK EQUATION 883

$$\mathrm{BLB} = 4.5 + 22.7 \times \left(\frac{DBH}{100}\right)^2 \times HT$$

EQUATION 19 BIOPAK EQUATION 925

$$\mathrm{BLB} = 5.3 + 9.7 \times \left(\frac{DBH}{100}\right)^2 \times HT$$

EQUATION 20 BIOPAK EQUATION 895

$$\mathrm{BLB} = 20.4 + 7.7 \times \left(\frac{DBH}{100}\right)^2 \times HT$$

EQUATION 21 BIOPAK EQUATION 446

$$\mathrm{BLB} = 0.626 + 0.00079 \times DBH^2 \times HT$$

EQUATION 22 BIOPAK EQUATION 859

$$\mathrm{BLB} = 12.6 + 23.5 \times \left(\frac{DBH}{100}\right)^2 \times HT$$

EQUATION 23 Weyerhaeuser Co Equation

$$\mathrm{BLB} = 0.047 + 0.00413 \times DBH^2 \times HT$$

EQUATION 24 BIOPAK EQUATION 913

$$\mathrm{BLB} = 4.2 + 17.4 \times \left(\frac{DBH}{100}\right)^2 \times HT$$

EQUATION 25 BIOPAK EQUATION 950

$$\mathrm{BLB} = -0.6 + 45.1 \times \left(\frac{DBH}{100}\right)^2 \times HT$$

WHERE

Log = NATURAL LOG
DBH = DIAMETER OF TREE IN CENTIMETERS
HT = HEIGHT OF TREE IN METERS
BLB = BIOMASS OF LIVE BRANCHES,
WEIGHT IN KILOGRAMS, OF THE WOOD AND BARK OF LIVE BRANCHES IN THE CROWN
π = 3.141593