forest management note

Note No. 14 Northern Forest Research Centre Edmonton, Alberta

WEIGHT TABLES FOR IMPORTANT TREE SPECIES IN THE PRAIRIE PROVINCES

Tables based on diameter and height measurements provide a convenient basis for estimating tree biomass for energy production. Weight tables are analogous to the volume tables traditionally used by foresters for timber and pulpwood estimates.

Diameter outside bark (D) at breast height (measured at 1.3 m) and total tree height (H) are two readily available measurements from most timber inventories. Tree biomass (dry weight) can be predicted by using those variables in the following model:

$$W = a_0 + a_1 D + a_2 H + a_3 D^2 H + a_4 D^2 + a_5 D^3$$

where W is the ovendry weight for the whole tree above ground (including stump but without foliage and cones). The model parameters (a_0, a_1,...,a_5) are regression coefficients determined by applying the method of least squares to field and laboratory sampled data.

The dry weight tables presented in this note were derived from data obtained in field and laboratory sampling of 60 trees of each of 10 species in Alberta, Saskatchewan, and Manitoba. Using the D and H measurements, regression equations were thus obtained for balsam fir, alpine fir, white birch, tamarack or eastern larch, white spruce, black spruce, jack pine, lodgepole pine, balsam poplar, and trembling aspen.

Details of the field and laboratory procedures used and the computer programs developed for the biomass computations and prediction equations are described by Singh (1982).

The tables are intended to provide weight values within the range of diameters and heights shown and are not meant to be used for smaller or larger trees. Table values may be interpolated to obtain approximate estimates for trees having other than the listed D and H. In addition, below each table is an alternative regression equation based on the model

$$W = a_0 + a_1 D + a_2 D^2 + a_3 D^3$$

Although the weight tables are based on field data gathered from the boreal and subalpine forest regions in the prairies, the results are potentially applicable to ecologically similar areas.

ACKNOWLEDGMENT

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T. Singh
August 1982

REFERENCE

Singh, T. 1982. Biomass equations for ten major tree species of the prairie provinces. Environ. Can., Can. For. Serv., North. For. Res. Cent. Edmonton, Alberta. Inf. Rep. NOR-X-242.

Balsam fir (*Abies balsamea* (L.) Mill.) whole tree aboveground (without foliage) dry weight (kg)

Dbh	Height (m)														
(cm)	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34
6	1	6													
8		6	10	15											
10		9	14	19	24										
12		15	21	26	32	37									
14		25	31	37	43	49	54								
16			45	51	58	64	70	76							
18			63	69	76	83	89	96	103						
20				91	98	105	112	119	126	134					
22				115	123	131	138	146	154	162	169				
24					151	160	168	176	185	193	201	210			
26					183	192	201	210	219	228	237	246	255		
28						228	237	247	257	267	276	286	296	306	
30						266	277	287	298	308	319	329	340	351	361
32							319	331	342	353	365	376	388	399	410
34							365	377	389	402	414	426	438	451	463
36								427	440	453	466	479	493	506	519
38								479	493	507	522	536	550	564	578
40									550	565	580	595	611	626	641

Equation: $W = 12.91000 - 7.02800D + 2.24300H + 0.00336D^2H + 0.46920D^2 - 0.00157D^3$ ($R^2 = 0.98$).
Equation based on D only: $W = 6.41900 - 2.51900D + 0.33730D^2 + 0.00200D^3$ ($R^2 = 0.98$).

White birch (*Betula papyrifera* Marsh.) whole tree aboveground (without foliage) dry weight (kg)

Dbh	Height (m)													
(cm)	8	10	12	14	16	18	20	22	24	26	28	30	32	34
6	T	6												
8	T	6	12	18										
10	8	14	19	25										
12	24	29	35	40	46									
14		52	57	63	68	73								
16		82	87	92	97	102	107							
18		119	123	128	132	137	141	146						
20			165	169	173	177	181	185	189					
22			213	217	220	224	227	231	234	238				
24				269	272	275	278	281	284	287	290			
26				326	329	331	334	336	338	341	343	345		
28					390	392	393	395	397	398	400	402	403	
30					455	456	457	458	459	460	461	462	463	464
32						524	524	524	524	525	525	525	525	526

T = trace.
Equation: $W = 28.37893 - 16.15575D + 3.22648H - 0.00303D^2H + 1.26124D^2 - 0.00859D^3$ ($R^2 = 0.96$).
Equation based on D only: $W = 30.26575 - 10.63240D + 1.03970D^2 - 0.00706D^3$ ($R^2 = 0.96$).

Alpine fir (*Abies lasiocarpa* (Hook.) Nutt.) whole tree aboveground (without foliage) dry weight (kg)

Dbh	Height (m)														
(cm)	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34
6	4														
8	6	6	7	7											
10	10	12	13	15	17										
12		19	22	25	29	32									
14		28	33	38	43	48	53								
16			46	53	60	66	73	80							
18			60	69	78	87	96	105	114						
20				86	97	109	120	132	143	155					
22				103	118	132	146	160	174	189	203				
24					138	155	173	190	207	224	242	259			
26					159	179	200	220	241	261	282	302	323		
28						203	227	251	275	299	323	347	371	395	
30						227	254	282	310	337	365	393	421	448	476
32							281	312	344	376	408	439	471	503	535
34							306	342	378	414	450	486	522	558	594
36								370	410	451	491	532	573	613	654
38								396	441	487	532	577	623	668	714
40									470	521	571	622	672	723	773

Equation: $W = 21.81342 - 4.95270D - 0.75442H + 0.01625D^2H + 0.41297D^2 - 0.00890D^3$ ($R^2 = 0.98$).
Equation based on D only: $W = 31.11285 - 9.36280D + 0.82440D^2 - 0.00760D^3$ ($R^2 = 0.97$).

Tamarack larch (*Larix laricina* (Du Roi) K. Koch) whole tree aboveground (without foliage) dry weight (kg)

Dbh	Height (m)														
(cm)	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34
6	5	10	16												
8	7	13	19	25											
10	11	17	24	30	37										
12		24	31	38	46	53									
14		33	41	49	57	65	73								
16			53	62	71	80	90	99							
18			68	78	88	98	109	119	129						
20				96	108	119	131	142	154	165					
22				117	130	143	156	169	182	194	207				
24					155	170	184	198	213	227	242	256			
26					183	199	215	231	248	264	280	296	312		
28						232	250	268	286	304	321	339	357	375	
30						268	288	308	327	347	367	387	406	426	446
32							329	351	373	394	416	438	460	482	504
34							373	397	421	445	469	494	518	542	566
36								448	474	500	527	553	579	606	632
38								501	530	559	588	617	645	674	703
40									590	621	653	684	716	747	779

Equation: $W = -4.71726 - 2.19912D + 2.42532H + 0.00830D^2H + 0.16916D^2 + 0.00104D^3$ ($R^2 = 0.98$).
Equation based on D only: $W = 13.73306 - 4.54319D + 0.53870D^2 - 0.00275D^3$ ($R = 0.98$).

White spruce (*Picea glauca* (Moench) Voss) whole tree aboveground (without foliage) dry weight (kg)

Dbh	Height (m)														
(cm)	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34
6	5	6	6												
8	11	12	13	13											
10	18	20	21	23	24										
12		29	31	34	36	38									
14		39	43	46	50	53	57								
16			56	61	65	70	75	80							
18			71	77	83	89	95	102	108						
20				96	103	111	118	126	134	141					
22				116	125	135	144	153	163	172	181				
24					150	161	172	183	195	206	217	228			
26					176	190	203	216	229	243	256	269	282		
28						221	236	252	267	283	298	313	329	344	
30						254	272	290	308	326	344	361	379	397	415
32							311	331	352	372	392	413	433	453	474
34							353	376	399	422	445	468	491	514	537
36								423	449	475	501	527	553	578	604
38								474	502	531	560	589	618	647	676
40									559	591	623	656	688	720	752

Equation: $W = -3.85515 + 1.00044D - 0.24810H + 0.01018D^2H + 0.06119D^2 + 0.00113D^3$ ($R^2 = 0.99$).
Equation based on D only: $W = 7.69727 - 3.23895D + 0.43412D^2 + 0.00060D^3$ ($R^2 = 0.98$).

Jack pine (*Pinus banksiana* Lamb.) whole tree aboveground (without foliage) dry weight (kg)

Dbh	Height (m)														
(cm)	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34
6	T	6	13												
8		7	14	22											
10		9	17	26	35										
12			22	32	42	52									
14			28	40	51	62	74								
16			37	50	62	75	88	101							
18				62	76	91	106	120	135						
20				76	92	109	126	143	159	176					
22				92	111	130	149	168	187	206	225				
24					133	154	175	197	218	240	261	283			
26					157	181	205	229	253	277	301	326	350		
28						210	237	265	292	319	346	373	400	427	
30						243	273	304	334	364	394	424	454	485	515
32							313	346	380	413	447	480	514	547	581
34							355	392	429	466	503	541	578	615	652
36								442	483	524	565	606	646	687	728
38								496	541	586	631	675	720	765	810
40									603	652	701	750	799	848	897

T = trace.
Equation: $W = -13.14671 - 1.65204D + 3.00210H + 0.01342D^2H + 0.01753D^2 + 0.00181D^3$ ($R^2 = 0.98$).
Equation based on D only: $W = 10.06313 - 4.11975D + 0.52630D^2 - 0.00127D^3$ ($R^2 = 0.96$).

Black spruce (*Picea mariana* (Mill.) BSP) whole tree aboveground (without foliage) dry weight (kg)

Dbh	Height (m)														
(cm)	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34
6	4														
8		10	18												
10		11	20	28	36										
12		16	24	33	42	51									
14		23	32	42	52	61	71								
16			43	54	65	75	86	96							
18			58	69	81	92	104	115	127						
20				88	100	113	126	138	151	164					
22				110	124	138	151	165	179	193	207				
24					151	166	181	196	211	226	242	257			
26					181	198	214	231	248	264	281	298	314		
28						234	252	270	288	306	325	343	361	379	
30						273	293	313	333	353	373	393	413	433	452
32							339	360	382	404	426	447	469	491	512
34							388	412	436	459	483	507	530	554	577
36								468	494	519	545	571	596	622	648
38								528	556	584	612	640	667	695	723
40								593	623	653	683	713	744	774	804

Equation: $W = 4.56422 - 5.36233D + 3.39266H + 0.00729D^2H + 0.26043D^2 + 0.00133D^3$ ($R^2 = 0.99$).
Equation based on D only: $W = 5.81313 - 2.99915D + 0.48658D^2 - 0.00086D^3$ ($R^2 = 0.99$).

Lodgepole pine (*Pinus contorta* Dougl. var. *latifolia* Engelm.) whole tree aboveground (without foliage) dry weight (kg)

Dbh	Height (m)														
(cm)	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34
6	T	4	7												
8	7	11	15	19											
10	13	18	23	28	33										
12		26	32	38	44	51									
14		34	42	49	57	65	72								
16			52	61	71	80	89	99							
18			63	75	86	97	108	120	131						
20				89	103	116	129	143	156	169					
22				105	121	137	152	168	184	199	215				
24					141	160	178	196	214	232	251	269			
26					164	185	206	227	248	269	290	311	332		
28						212	236	260	284	308	332	356	380	404	
30						242	269	297	324	351	378	405	432	460	487
32							305	336	367	397	428	459	489	520	550
34							345	379	413	447	482	516	550	584	619
36								425	463	501	539	578	616	654	692
38								475	517	559	601	644	686	728	770
40									574	621	668	714	761	807	854

T = trace.
Equation: $W = -26.91929 + 3.77558D + 1.12097H + 0.01385D^2H - 0.15742D^2 + 0.00297D^3$ ($R^2 = 0.99$).
Equation based on D only: $W = -2.71219 - 0.93774D + 0.29884D^2 + 0.00285D^3$ ($R^2 = 0.97$).

Balsam poplar (*Populus balsamifera* L.) whole tree aboveground (without foliage) dry weight (kg)

Dbh	Height (m)														
(cm)	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34
6	2	6	10												
8	4	8	12	16											
10	9	13	18	22	27										
12		22	26	31	36	41									
14		33	38	43	48	53	58								
16			52	58	63	69	74	80							
18			69	75	81	87	93	99	105						
20				95	101	108	114	121	128	134					
22				117	124	131	138	145	153	160	167				
24					149	157	165	172	180	188	196	204			
26					176	185	193	202	210	219	227	236	244		
28						214	224	233	242	251	261	270	279	288	
30						246	256	266	276	286	296	307	317	327	337
32							290	301	312	323	334	345	356	367	378
34							326	338	350	362	374	386	398	410	421
36								377	389	402	415	428	441	454	467
38								416	430	444	458	472	486	500	514
40									472	487	502	517	533	548	563

Equation: $W = 4.02873 - 4.84860D + 1.85135H + 0.00354D^2H + 0.43221D^2 - 0.00304D^3$ ($R^2 = 0.98$).
Equation based on D only: $W = 7.88378 - 3.84748D + 0.51417D^2 - 0.00319D^3$ ($R^2 = 0.97$).

Trembling aspen (*Populus tremuloides* Michx.) whole tree aboveground (without foliage) dry weight (kg)

Dbh	Height (m)														
(cm)	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34
6	15														
8		20													
10			29												
12				40											
14				57											
16				75	77	80	82	85							
18				94	99	104	110	115	120						
20				113	122	131	139	148	156	165					
22					146	159	171	183	195	207	219				
24					172	188	205	221	237	253	269	285			
26					200	220	241	261	281	302	322	343	363		
28						254	279	304	329	354	379	405	430	455	
30						290	320	350	380	410	440	470	500	531	561
32							364	399	434	470	505	541	576	611	647
34							410	451	492	533	574	615	656	697	738
36								506	553	600	647	694	741	789	836
38								564	618	671	725	778	832	885	938
40									686	746	806	866	927	987	1047

Equation: $W = 2.39343 + 6.95977D - 4.31874H + 0.02150D^2H - 0.23719D^2 + 0.00192D^3$ ($R^2 = 0.99$).
Equation based on D only: $W = 23.61521 - 7.88903D + 0.78372D^2 - 0.00362D^3$ ($R^2 = 0.98$).

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