NORTH CENTRAL FOREST EXPERIMENT STATION

Research Note NC-299

1992 FOLWELL AVE. ST. PAUL, MN 55108 FOREST SERVICE-U.S.D.A.

1983

ALLOMETRIC BIOMASS EQUATIONS FOR 98 SPECIES OF HERBS, SHRUBS, AND SMALL TREES

W. Brad Smith, *Mensurationist*,
and **Gary J. Brand**, *Associate Mensurationist*

ABSTRACT.—Biomass regression coefficients from the literature for the allometric equation form are presented for 98 species of shrubs and herbs in the northern U.S. and Canada. The equation and coeffients provide estimates of grams of biomass (ovendry weight) for foliage, woody stem and total biomass.

KEY WORDS: Regression, metric, dry weight, herbs, shrubs.

Biomass estimates for herbs and shrubs have many uses in determining wildlife habitat and forest fuel conditions. Although many independent variables and equations have been chosen in biomass studies, the simple allometric equation is most frequently used (Stanek and State 1978, Hitchcock and McDonnell 1979). This equation for predicting biomass in grams (Y) from stem diameter or percent cover (X) has two forms:

$$Y = aX^b \quad (1)$$

or

$$\ln Y = a + b \ln X, \quad (2).$$

The purpose of this paper is to compile coefficients for these equations for species in eastern Canada and the northern United States from seven sources (Telfer 1969, Grigal and Ohmann 1977, Ohmann *et al.* 1976, Brown 1976, Roussopoulos and Loomis 1979, Ohmann *et al.* 1981, Connolly 1981).

For convenience, Eq. 2 may be put in the form of Eq. 1 by solving for Y and transforming the coefficients. The new equation becomes:

$$Y = a' X^b \quad (3)$$

where $a' = e^a$ and coefficients a and b are the same as in Eq. 2. The equation coefficients from Ohmann *et al.* (1976), Grigal and Ohmann (1977), Roussopoulos and Loomis (1979), Ohmann *et al.* (1981), and Connolly (1981) are taken directly from the original sources. Telfer (1969) and Brown (1976) reported coefficients for the logarithmic form, which we converted. Telfer's coefficients were additionally adjusted to convert the independent variable from basal diameter in mm to cm. Thus, for Telfer $a' = e^a 10^b$ in Eq. 3.

Roussopoulos and Loomis fit their data to Eq. 2 but converted these coefficients after correcting for the bias inherent in the fitting of the logarithmic form (Baskerville 1972, Yandle and Wiant 1981). Brown indicated that the effects of this bias on his biomass estimates ranged from 2 to 9 percent with an average of 5 percent. The coefficients presented by Brown are unadjusted for bias, as are those presented by Telfer. All coefficients presented are for estimating biomass in grams ovendry weight.

One caution is necessary: some of the equations use stem diameter at 15 cm as the independent variable and others use basal diameter. Roussopoulos and Loomis (1979) present a regression technique for estimating basal diameter at 15 cm, thereby facilitating the use of basal diameter equations even though field measurements may have been collected at 15 cm.

Refer to the original publications for details about methods, specific locations of data sources, or any other questions regarding the biomass studies.

Table 1.--Coefficients and related statistics for the allometric relationship, Biomass = aX^b

Species	Biomass key[1]	Independent variable (x)[2]	Coefficients a	Coefficients b	Number of observations	R^2	Range of independent variable	Location[3]	Source
Tree seedlings and saplings									
Abies balsamea	T	D2	72.715	2.250	25	0.96	0.50-3.30	MN	Roussopoulos and Loomis (1979)
	W	D2	42.904	2.404	25	.97	0.50-3.30	MN	Roussopoulos and Loomis (1979)
	F	D2	29.319	2.011	25	.94	0.50-3.30	MN	Roussopoulos and Loomis (1979)
Acer rubrum	W	D2	21.730	3.654	10	.91	0.50-1.75	MN	Grigal and Ohmann (1977)
	T	D2	60.367	2.342	36	.94	0.30-4.10	MN	Roussopoulos and Loomis (1979)
	W	D2	45.947	2.505	36	.93	0.30-4.10	MN	Roussopoulos and Loomis (1979)
	F	D2	13.082	1.840	36	.91	0.30-4.10	MN	Roussopoulos and Loomis (1979)
Betula papyrifera	W	D2	22.865	3.502	10	.76	0.50-1.75	MN	Grigal and Ohmann (1977)
	F	D2	3.421	1.838	4	.99	0.50-1.75	MN	Grigal and Ohmann (1977)
	T	D2	76.316	2.279	23	.93	1.30-3.60	MN	Roussopoulos and Loomis (1979)
	W	D2	62.830	2.378	23	.93	1.30-3.60	MN	Roussopoulos and Loomis (1979)
	F	D2	14.717	1.529	23	.66	1.30-3.60	MN	Roussopoulos and Loomis (1979)
Fagus grandifolia	T	D1	20.996	2.906	20	.99	0.18-3.55	Canada	Telfer (1969)
	F	D1	4.528	2.354	20	.99	0.18-3.55	Canada	Telfer (1969)
Picea spp.	T	D2	65.757	2.287	25	.97	0.50-3.30	MN	Roussopoulos and Loomis (1979)
	W	D2	28.670	2.566	25	.98	0.50-3.30	MN	Roussopoulos and Loomis (1979)
	F	D2	36.288	2.047	25	.95	0.50-3.30	MN	Roussopoulos and Loomis (1979)
Populus spp.	T	D2	46.574	2.527	27	.96	0.50-3.30	MN	Roussopoulos and Loomis (1979)
	W	D2	35.264	2.657	27	.97	0.50-3.30	MN	Roussopoulos and Loomis (1979)
	F	D2	10.828	2.052	27	.87	0.50-3.30	MN	Roussopoulos and Loomis (1979)
Populus tremuloides	W	D2	34.502	2.874	28	.91	0.50-1.75	MN	Grigal and Ohmann (1977)
	F	D2	2.227	4.258	14	.96	0.50-1.75	MN	Grigal and Ohmann (1977)
	T	D1	27.980	2.715	20	.99	0.23-4.06	Canada	Telfer (1969)
	F	D1	9.849	2.156	20	.96	0.23-4.06	Canada	Telfer (1969)
Quercus rubra	T	D1	44.726	2.649	20	.99	0.22-3.99	Canada	Telfer (1969)
	F	D1	11.694	2.198	20	.97	0.22-3.99	Canada	Telfer (1969)
Thuja occidentalis	T	D2	68.423	1.863	38	.94	0.30-5.10	MN	Roussopoulos and Loomis (1979)
	W	D2	30.800	2.244	38	.94	0.30-5.10	MN	Roussopoulos and Loomis (1979)
	F	D2	35.288	1.442	38	.90	0.30-5.10	MN	Roussopoulos and Loomis (1979)

(Table 1 continued on next page)

(Table 1 continued)

Species	Biomass key[1]	Independent variable (x)[2]	Coefficients a	Coefficients b	Number of observations	R^2	Range of independent variable	Location[3]	Source
Tall shrubs									
Acer glabrum	T	D1	37.864	2.752	31	0.98	0.40-3.70	MT, ID	Brown (1976)
	F	D1	6.475	2.038	31	.89	0.40-3.70	MT, ID	Brown (1976)
Acer pensylvanicum	T	D1	22.395	2.878	20	.99	0.92-4.31	Canada	Telfer (1969)
	F	D1	5.916	2.220	20	.98	0.92-4.31	Canada	Telfer (1969)
Acer spicatum	W	D2	43.660	2.630	27	.78	0.50-1.75	MN	Grigal and Ohmann (1977)
	F	D2	2.869	3.669	11	.61	0.50-1.75	MN	Grigal and Ohmann (1977)
	T	D2	52.090	2.724	45	.92	0.70-3.20	MN	Ohmann et al. (1976)
	W	D2	40.940	2.781	90	.93	0.60-3.20	MN	Ohmann et al. (1976)
	F	D2	11.130	2.123	45	.80	0.70-3.20	MN	Ohmann et al. (1976)
	T	D2	73.182	2.259	25	.95	0.30-4.30	MN	Roussopoulos and Loomis (1979)
	W	D2	54.779	2.407	25	.95	0.30-4.30	MN	Roussopoulos and Loomis (1979)
	F	D2	17.305	1.696	25	.89	0.30-4.30	MN	Roussopoulos and Loomis (1979)
Alnus crispa	W	D2	39.684	2.696	26	.86	0.50-1.75	MN	Grigal and Ohmann (1977)
	F	D2	5.650	2.222	25	.75	0.50-1.75	MN	Grigal and Ohmann (1977)
	T	D2	55.450	2.409	45	.94	0.70-2.10	MN	Ohmann et al. (1976)
	W	D2	43.940	2.214	90	.87	0.60-2.10	MN	Ohmann et al. (1976)
	F	D2	13.970	1.682	45	.63	0.70-2.10	MN	Ohmann et al. (1976)
Alnus rugosa	W	D2	31.328	3.050	15	.99	0.50-1.75	MN	Grigal and Ohmann (1977)
	F	D2	3.123	3.071	12	.72	0.50-1.75	MN	Grigal and Ohmann (1977)
	T	D2	33.722	2.712	29	.96	0.25-3.00	MN	Connolly (1981)
	W	D2	23.138	3.018	29	.96	0.25-3.00	MN	Connolly (1981)
	F	D2	13.540	0.845	29	.65	0.25-3.00	MN	Connolly (1981)
Alnus sinuata	T	D1	33.886	2.466	30	.95	0.70-6.30	MT, ID	Brown (1976)
	F	D1	7.885	1.588	30	.82	0.70-6.30	MT, ID	Brown (1976)
Alnus spp.	T	D2	63.280	2.380	28	.93	0.80-4.10	MN	Roussopoulos and Loomis (1979)
	W	D2	48.762	2.509	28	.90	0.80-4.10	MN	Roussopoulos and Loomis (1979)
	F	D2	14.725	1.828	28	.90	0.80-4.10	MN	Roussopoulos and Loomis (1979)
Amelanchier alnifolia	T	D1	36.855	2.887	39	.99	0.40-4.50	MT, ID	Brown (1976)
	F	D1	5.425	2.111	39	.83	0.40-4.50	MT, ID	Brown (1976)
Amelanchier spp.	W	D2	37.909	2.963	27	.92	0.50-1.75	MN	Grigal and Ohmann (1977)
	F	D2	5.432	2.008	14	.88	0.50-1.75	MN	Grigal and Ohmann (1977)
	T	D2	64.180	2.322	45	.83	0.50-1.90	MN	Ohmann et al. (1976)
	W	D2	50.630	2.547	90	.90	0.50-1.90	MN	Ohmann et al. (1976)
	F	D2	13.340	1.547	45	.47	0.50-1.90	MN	Ohmann et al. (1976)
	T	D2	71.534	2.391	27	.93	0.50-4.10	MN	Roussopoulos and Loomis (1979)
	W	D2	60.997	2.445	27	.94	0.50-4.10	MN	Roussopoulos and Loomis (1979)
	F	D2	10.478	1.988	27	.83	0.50-4.10	MN	Roussopoulos and Loomis (1979)
Artemisia tridentata	T	D1	23.594	2.242	22	.92	0.80-6.90	MT, ID	Brown (1976)
	F	D1	4.968	1.888	22	.75	0.80-6.90	MT, ID	Brown (1976)
Betula pumila	T	D2	59.777	2.579	36	.96	0.25-2.25	MN	Connolly (1981)
	W	D2	53.283	2.689	36	.96	0.25-2.25	MN	Connolly (1981)
	F	D2	6.265	1.106	36	.52	0.25-2.25	MN	Connolly (1981)
Ceanothus velutinus	T	D1	39.252	2.847	30	.92	0.60-2.50	MT, ID	Brown (1976)
	F	D1	14.688	2.415	30	.67	0.60-2.50	MT, ID	Brown (1976)

(Table 1 continued on next page)

(Table 1 continued)

Species	Biomass key[1]	Independent variable (x)[2]	Coefficients a	Coefficients b	Number of observations	R^2	Range of independent variable	Location[3]	Source
Cornus rugosa	W	D2	32.421	3.152	9	0.96	0.50-1.50	MN	Grigal and Ohmann (1977)
	F	D2	8.616	2.541	9	.94	0.50-1.50	MN	Grigal and Ohmann (1977)
	T	D2	74.114	2.457	27	.96	0.30-3.60	MN	Roussopoulos and Loomis (1979)
	W	D2	55.886	2.591	27	.96	0.30-3.60	MN	Roussopoulos and Loomis (1979)
	F	D2	17.131	2.093	27	.93	0.30-3.60	MN	Roussopoulos and Loomis (1979
Cornus stolonifera	T	D1	39.646	2.575	31	.93	0.60-3.40	MT, ID	Brown (1976)
	F	D1	9.450	1.762	31	.58	0.60-3.40	MT, ID	Brown (1976)
	T	D2	32.791	3.806	33	.89	0.25-1.75	MN	Connolly (1981)
	W	D2	25.515	4.039	33	.89	0.25-1.75	MN	Connolly (1981)
	F	D2	7.992	2.440	33	.73	0.25-1.75	MN	Connolly (1981)
Corylus cornuta	W	D2	38.031	3.267	43	.85	0.50-1.75	MN	Grigal and Ohmann (1977)
	F	D2	4.808	3.571	9	.99	0.50-1.75	MN	Grigal and Ohmann (1977)
	T	D2	54.100	1.229	45	.13	0.60-2.30	MN	Ohmann et al. (1976)
	W	D2	38.570	1.582	90	.20	0.60-2.30	MN	Ohmann et al. (1976)
	T	D2	62.819	2.420	36	.89	0.30-2.50	MN	Roussopoulos and Loomis (1979)
	W	D2	50.154	2.523	36	.90	0.30-2.50	MN	Roussopoulos and Loomis (1979)
	F	D2	12.115	2.010	36	.81	0.30-2.50	MN	Roussopoulos and Loomis (1979)
Gaylussacia baccata	T	D1	44.942	2.156	22	.86	0.46-2.57	Canada	Telfer (1969)
	F	D1	13.950	1.502	22	.65	0.46-2.57	Canada	Telfer (1969)
Hamamelis virginiania	T	D1	38.111	2.900	21	.99	0.18-4.31	Canada	Telfer (1969)
	F	D1	9.480	2.162	20	.96	0.18-4.31	Canada	Telfer (1969)
Holodiscus discolor	T	D1	43.337	3.033	31	.93	0.70-2.70	MT, ID	Brown (1976)
	F	D1	8.706	2.605	31	.86	0.70-2.70	MT, ID	Brown (1976)
Ilex verticillata	T	D1	53.497	3.340	20	.94	0.19-0.90	Canada	Telfer (1969)
	F	D1	10.747	2.851	20	.93	0.19-0.90	Canada	Telfer (1969)
Juniperus communis	T	D1	59.205	2.202	23	.92	0.80-2.90	MT, ID	Brown (1976)
	F	D1	30.387	1.650	23	.80	0.80-2.90	MT, ID	Brown (1976)
Lonicera utahensis	T	D1	43.293	2.957	32	.92	0.30-1.70	MT, ID	Brown (1976)
	F	D1	7.404	2.158	32	.67	0.30-1.70	MT, ID	Brown (1976)
Menziesia ferruginea	T	D1	21.607	3.150	37	.98	0.40-2.10	MT, ID	Brown (1976)
	F	D1	1.937	2.263	37	.83	0.40-2.10	MT, ID	Brown (1976)
Nemopanthus mucronatus	T	D1	31.532	2.819	20	.97	0.16-2.85	Canada	Telfer (1969)
	F	D1	4.246	2.231	20	.97	0.16-2.85	Canada	Telfer (1969)
Philadelphus lewisii	T	D1	40.772	2.999	28	.90	0.50-2.90	MT, ID	Brown (1976)
	F	D1	6.828	2.778	28	.71	0.50-2.90	MT, ID	Brown (1976)
Physocarpus malvaceus	T	D1	41.679	2.576	38	.94	0.40-3.80	MT, ID	Brown (1976)
	F	D1	9.728	2.036	38	.89	0.40-3.80	MT, ID	Brown (1976)
Prunus pensylvanica	W	D2	49.916	2.547	9	.95	0.50-1.75	MN	Grigal and Ohmann (1977)
	F	D2	4.947	2.836	3	.00	0.50-1.75	MN	Grigal and Ohmann (1977)
Prunus spp.	T	D2	68.041	2.237	25	.90	0.80-3.80	MN	Roussopoulos and Loomis (1979)
	W	D2	55.076	2.306	25	.87	0.80-3.80	MN	Roussopoulos and Loomis (1979)
	F	D2	12.382	2.024	25	.77	0.80-3.80	MN	Roussopoulos and Loomis (1979)

(Table 1 continued on next page)

(Table 1 continued)

Species	Biomass key[1]	Independent variable (x)[2]	Coefficients a	Coefficients b	Number of observations	R^2	Range of independent variable	Location[3]	Source
Prunus virginiana	T	D1	9.934	2.920	31	0.98	0.60-2.90	MT, ID	Brown (1976)
	F	D1	8.846	1.902	31	.74	0.60-2.90	MT, ID	Brown (1976)
	W	D2	35.575	2.704	9	.86	0.25-1.25	MN	Grigal and Ohmann (1977)
	F	D2	7.953	1.954	4	.90	0.25-1.25	MN	Grigal and Ohmann (1977)
Salix spp.	T	D1	27.194	2.762	31	.97	0.70-3.70	MT, ID	Brown (1976)
	F	D1	6.411	2.066	31	.68	0.70-3.70	MT, ID	Brown (1976)
	W	D2	17.815	4.919	9	.92	0.50-1.75	MN	Grigal and Ohmann (1977)
	F	D2	4.514	3.692	9	.89	0.50-1.75	MN	Grigal and Ohmann (1977)
	T	D2	87.790	1.981	36	.87	0.80-3.80	MN	Ohmann *et al.* (1976)
	W	D2	56.090	2.208	90	.92	0.60-3.80	MN	Ohmann *et al.* (1976)
	F	D2	21.590	1.686	36	.54	0.70-3.80	MN	Ohmann *et al.* (1976)
	T	D2	55.925	2.594	25	.96	0.5-3.00	MN	Roussopoulos and Loomis (1979)
	W	D2	43.316	2.726	25	.95	0.50-3.00	MN	Roussopoulos and Loomis (1979)
	F	D2	12.280	2.120	25	.94	0.50-3.00	MN	Roussopoulos and Loomis (1979)
	T	D1	46.271	2.325	20	.97	0.45-3.41	Canada	Telfer (1969)
	F	D1	14.256	1.729	20	.82	0.45-3.41	Canada	Telfer (1969)
	T	D2	60.153	2.202	72	.83	0.25-3.00	MN	Connolly (1981)
	W	D2	41.287	2.565	72	.87	0.25-3.00	MN	Connolly (1981)
	F	D2	13.194	1.224	72	.64	0.25-3.00	MN	Connolly (1981)
Shepherdia canadensis	T	D1	33.016	2.407	30	.89	0.70-2.90	MT, ID	Brown (1976)
	F	D1	7.463	2.034	30	.80	0.70-2.90	MT, ID	Brown (1976)
Sorbus americana	W	D2	13.982	4.900	9	.92	0.50-1.75	MN	Grigal and Ohmann (1977)
	F	D2	2.885	3.454	3	.00	0.50-1.75	MN	Grigal and Ohmann (1977)
	T	D2	44.394	3.253	24	.95	0.50-3.80	MN	Roussopoulos and Loomis (1979)
	W	D2	35.960	3.427	24	.95	0.50-3.80	MN	Roussopoulos and Loomis (1979)
	F	D2	8.083	2.601	24	.93	0.50-3.80	MN	Roussopoulos and Loomis (1979)
Sorbus scopulina	T	D1	26.390	2.881	29	.95	1.00-4.20	MT, ID	Brown (1976)
	F	D1	4.468	2.581	29	.84	1.00-4.20	MT, ID	Brown (1976)
Viburnum lantanoides	T	D1	29.615	3.243	19	.95	0.28-1.59	Canada	Telfer (1969)
	F	D1	6.182	2.679	19	.92	0.28-1.59	Canada	Telfer (1969)
	T	D1	43.570	2.774	20	.98	0.29-3.10	Canada	Telfer (1969)
	F	D1	7.143	2.205	20	.95	0.29-3.10	Canada	Telfer (1969)
Viburnum rafinesquianum	W	D2	39.921	4.132	9	.98	0.50-1.50	MN	Grigal and Ohmann (1977)
	F	D2	8.526	3.007	8	.95	0.50-1.50	MN	Grigal and Ohmann (1977)
Medium and low shrubs									
Berberis repens	T	D1	19.609	2.092	36	.70	0.30-0.90	MT,ID	Brown (1976)
	F	D1	8.174	1.586	36	.48	0.30-0.90	MT,ID	Brown (1976)
Chamaedaphne calyculata	T	D1	41.330	2.626	20	.94	0.14-0.82	Canada	Telfer (1969)
	F	D1	10.556	2.220	20	.89	0.14-0.82	Canada	Telfer (1969)
Comptonia peregrina	T	D1	44.691	3.314	20	.97	0.21-1.48	Canada	Telfer (1969)
	F	D1	13.585	3.014	20	.97	0.21-1.48	Canada	Telfer (1969)
Diervilla lonicera	T	D2	14.211	1.217	21	.45	0.30-0.50	MN	Roussopoulos and Loomis (1979)
	W	D2	12.269	1.608	21	.53	0.30-0.50	MN	Roussopoulos and Loomis (1979)
	F	D2	3.082	0.613	21	.19	0.30-0.50	MN	Roussopoulos and Loomis (1979)

(Table 1 continued on next page)

(Table 1 continued)

Species	Biomass key[1]	Independent variable (x)[2]	Coefficients a	Coefficients b	Number of observations	R^2	Range of independent variable	Location[3]	Source
Ilex glabra	T	D1	55.096	3.011	20	0.91	0.23-1.87	Canada	Telfer (1969)
	F	D1	18.947	2.722	20	.81	0.23-1.87	Canada	Telfer (1969)
Kalmia angustifolia	T	D1	26.692	2.384	20	.95	0.09-0.87	Canada	Telfer (1969)
	F	D1	8.497	2.091	20	.90	0.09-0.87	Canada	Telfer (1969)
Ledum groenlandicum	T	D1	37.597	2.832	22	.96	0.23-0.83	Canada	Telfer (1969)
	F	D1	12.331	2.413	22	.90	0.23-0.83	Canada	Telfer (1969)
Lonicera canadensis	W	D2	28.090	2.166	9	.93	0.25-1.25	MN	Grigal and Ohmann (1977)
	F	D2	6.592	2.681	4	.90	0.25-1.25	MN	Grigal and Ohmann (1977)
	T	D2	33.900	1.793	25	.68	0.30-1.00	MN	Roussopoulos and Loomis (1979)
	W	D2	28.899	1.942	25	.67	0.30-1.00	MN	Roussopoulos and Loomis (1979)
	F	D2	5.319	1.275	25	.39	0.30-1.00	MN	Roussopoulos and Loomis (1979)
	T	D1	51.996	2.770	20	.96	0.12-0.69	Canada	Telfer (1969)
	F	D1	15.610	2.399	20	.86	0.12-0.69	Canada	Telfer (1969)
Lonicera hirsuta	W	D2	46.002	3.402	13	.68	0.25-1.00	MN	Grigal and Ohmann (1977)
	F	D2	3.926	1.163	10	.24	0.25-1.00	MN	Grigal and Ohmann (1977)
Lonicera oblongifolia	W	D2	18.093	3.089	4	.70	0.25-0.50	MN	Grigal and Ohmann (1977)
	F	D2	6.009	3.115	4	.75	0.25-0.50	MN	Grigal and Ohmann (1977)
Myrica pensylvanica	T	D1	60.795	2.867	20	.98	0.19-1.20	Canada	Telfer (1969)
	F	D1	18.361	2.529	20	.93	0.19-1.20	Canada	Telfer (1969)
Rhamnus alnifolia	W	D2	30.971	2.764	6	.87	0.50-1.75	MN	Grigal and Ohmann (1977)
	F	D2	2.009	3.835	6	.88	0.50-1.75	MN	Grigal and Ohmann (1977)
Rhododendron canadense	T	D1	24.079	2.612	20	.92	0.28-1.07	Canada	Telfer (1969)
	F	D1	5.183	2.050	20	.83	0.28-1.07	Canada	Telfer (1969)
Ribes spp.	T	D1	49.001	3.112	37	.90	0.40-1.40	MT, ID	Brown (1976)
	F	D1	8.706	2.538	37	.63	0.40-1.40	MT, ID	Brown (1976)
	W	D2	32.001	5.256	9	.78	0.25-0.75	MN	Grigal and Ohmann (1977)
	F	D2	1.513	3.023	9	.55	0.25-0.75	MN	Grigal and Ohmann (1977)
Rosa acicularis	W	D2	14.527	3.042	8	.88	0.25-0.75	MN	Grigal and Ohmann (1977)
	F	D2	3.286	2.004	8	.88	0.25-0.75	MN	Grigal and Ohmann (1977)
	T	D2	83.240	2.837	23	.83	0.30-1.30	MN	Roussopoulos and Loomis (1979)
	W	D2	63.140	3.224	23	.82	0.30-1.30	MN	Roussopoulos and Loomis (1979)
	F	D2	22.853	2.282	23	.79	0.30-1.30	MN	Roussopoulos and Loomis (1979)
Rosa blanda	W	D2	31.182	4.074	9	.84	0.25-0.75	MN	Grigal and Ohmann (1977)
	F	D2	4.160	2.302	9	.60	0.25-0.75	MN	Grigal and Ohmann (1977)
Rosa spp.	T	D1	37.637	2.779	32	.96	0.20-1.20	MT, ID	Brown (1976)
	F	D1	7.561	2.112	32	.88	0.20-1.20	MT, ID	Brown (1976)
Rubus idaeus	T	D1	43.992	2.860	26	.89	0.30-0.90	MT, ID	Brown (1976)
	F	D1	18.394	2.932	26	.85	0.30-0.90	MT, ID	Brown (1976)
Rubus parviflorus	T	D1	32.105	2.538	27	.88	0.30-1.40	MT, ID	Brown (1976)
	F	D1	12.146	2.024	27	.72	0.30-1.40	MT, ID	Brown (1976)

(Table 1 continued on next page)

(Table 1 continued)

Species	Biomass key[1]	Independent variable (x)[2]	Coefficients a	Coefficients b	Number of observations	R^2	Range of Independent variable	Location[3]	Source
Rubus strigosus	W	D2	11.519	4.032	11	0.73	0.25-0.75	MN	Grigal and Ohmann (1977)
	F	D2	7.081	3.871	11	.75	0.25-0.75	MN	Grigal and Ohmann (1977)
Spirea alba	T	D2	40.932	2.658	18	.96	0.25-1.25	MN	Connolly (1981)
	W	D2	32.031	3.092	18	.95	0.25-1.25	MN	Connolly (1981)
	F	D2	8.013	1.444	18	.66	0.25-1.25	MN	Connolly (1981)
Spiraea betulifolia	T	D1	36.745	2.604	31	.84	0.20-0.80	MT, ID	Brown (1976)
	F	D1	11.130	2.281	31	.80	0.20-0.80	MT, ID	Brown (1976)
Spiraea spp.	T	D1	36.648	2.579	20	.91	0.10-1.26	Canada	Telfer (1969)
	F	D1	5.493	1.720	20	.90	0.10-1.26	Canada	Telfer (1969)
Symphoricarpos albus	T	D1	32.786	2.285	31	.88	0.20-1.20	MT, ID	Brown (1976)
	F	D1	6.437	1.721	31	.68	0.20-1.20	MT, ID	Brown (1976)
Vaccinium globulare	T	D1	29.607	3.150	44	.97	0.30-1.70	MT, ID	Brown (1976)
	F	D1	4.393	2.537	44	.84	0.30-1.70	MT, ID	Brown (1976)
Vaccinium scoparium	T	D1	22.488	2.148	31	.62	0.30-0.70	MT, ID	Brown (1976)
	F	D1	1.670	1.567	31	.26	0.30-0.70	MT, ID	Brown (1976)
Vaccinium spp.	T	D1	95.143	3.706	20	.94	0.14-0.56	Canada	Telfer (1969)
	F	D1	13.224	3.034	20	.74	0.14-0.56	Canada	Telfer (1969)

[1] Biomass in grams ovendry weight: T = total aboveground biomass; W = woody aboveground biomass; and F = foliage biomass.

[2] D1 = basal diameter in cm and D2 = diameter at 15 cm aboveground in cm.

[3] Canada = Maritime Provinces, ID = northern Idaho, MN = northern Minnesota, and MT = western Montana.

LITERATURE CITED

Baskerville, G. L. Use of logarithmic regression in the estimation of plant biomass. Can. J. For. Res. 2(1): 49-53; 1972.

Brown, J. K. Estimating shrub biomass from basal stem diameters. Can. J. For. Res. 6(2): 153-158; 1976.

Connolly, B. J. Shrub biomass-soil relationships in Minnesota wetlands. 1981. Unpublished masters thesis, University of Minnesota, Department of Soil Science. 188 p.

Grigal, D. F.; Ohmann, L. F. Biomass estimation for some shrubs from northeastern Minnesota. Res. Note. NC-226. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1977. 3 p.

Hitchcock, H. C.; McDonnell, J. P. Biomass measurement: a synthesis of the literature. Ft Collins, CO: IUFRO workshop proceedings on Forest Resource Inventories, July 23-26. (2): 544-595; 1979.

Ohmann, L. F.; Grigal, D. F.; Brander, R. B. Biomass estimation for five shrubs from northeastern Minnesota. Res. Pap. NC-133. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1976. 11 p.

Ohmann, L. F.; Grigal, D. F.; Rogers, L. L. Estimating plant biomass for undergrowth species of northeastern Minnesota. Gen. Tech. Rep. NC-61. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1981. 10 p.

Roussopoulos, P. J.; Loomis, R. M. Weights and dimensional properties of shrubs and small trees of the Great Lakes conifer forest. Res. Pap. NC-178. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 1979. 6 p.

Stanek, W.; State, D. Equations predicting primary productivity (biomass) of trees, shrubs, and lesser vegetation based on current literature. Rep. BC-X-183. Victoria, BC: Canadian Forestry Service, Pacific Forest Research Centre; 1978. 58 p.

Telfer, E. S. Weight-diameter relationships for 22 woody plant species. Can. J. Bot. 47: 1851-1855; 1969.

Yandle, D. O.; Wiant, H. V., Jr. Estimation of plant biomass based on the allometric equation. Can. J. For. Res. 11: 833-834; 1981.

Table 2.--Coefficients and related statistics for the allometric relationship, Biomass = aX^b

Species	Biomass key [1/]	Independent variable (X) [2/]	Coefficients [3/] a	Coefficients [3/] b	Number of observations	R^2
Herbaceous vegetation						
Anemone spp.	G18	PC	0.0142	1.8387	56	0.72
Apocynum androsaemifolium	G18	PC	.2524	0.7750	21	.38
Aralia nudicaulis	G18	PC	.1062	1.0205	135	.56
Aster ciliolatus	G18	PC	.1247	0.9985	15	.81
Aster macrophyllus	G18	PC	.1192	1.0226	344	.50
Clintonia borealis	G18	PC	.1551	0.7616	108	.47
Cornus canadensis	G18	PC	.1376	0.9214	155	.63
Epilobium angustifolium	G18	PC	.3423	1.1588	18	.23
Fragaria spp.	G18	PC	.2227	0.7104	81	.42
Galium spp.	G18	PC	.0134	1.8697	30	.92
Gramineae	G18	PC	.9740	0.6750	137	.45
Lathyrus spp.	G18	PC	.4043	0.6873	62	.57
Linnaea borealis	G18	PC	.3650	0.8354	62	.84
Mainthemum canadense	G18	PC	.0650	1.0481	134	.46
Pteridium aquilinum	G18	PC	.4590	0.7669	15	.55
Pyrola spp	G18	PC	.1272	0.4472	46	.95
Streptopus roseus	G18	PC	.0660	0.9272	168	.57
Trientalis borealis	G18	PC	.0072	1.8320	19	.99
Viola spp.	G18	PC	.0588	0.7776	20	.81
Shrubs						
Diervilla lonicera	G18	PC	.3238	0.8601	21	.68
Ledum groenlandicum	G18	PC	.0001	3.3410	6	.62
Lonicera canadensis	G18	PC	.2727	0.9266	25	.93
Rosa spp.	G18	PC	.3964	0.7867	68	.50
Rubus parviflorus	G18	PC	.2508	0.7885	18	.60
Rubus pubescens	G18	PC	.0214	1.6346	168	.78
Rubus strigosus	G18	PC	.1601	1.1089	119	.64
Vaccinium angustifolium	G18	PC	.1496	1.2458	104	.72
Vaccinium myrtilloides	G18	PC	.3747	0.9340	82	.59

[1/] G18 = total aboveground biomass per 1,800 cm^2 (ovendry weight).
[2/] PC = ground cover in percent.
[3/] Source for coefficients is Ohmann *et al.* (1981). Data collected in northern Minnesota.

U.S. GOVERNMENT PRINTING OFFICE:1983-666-600/5016