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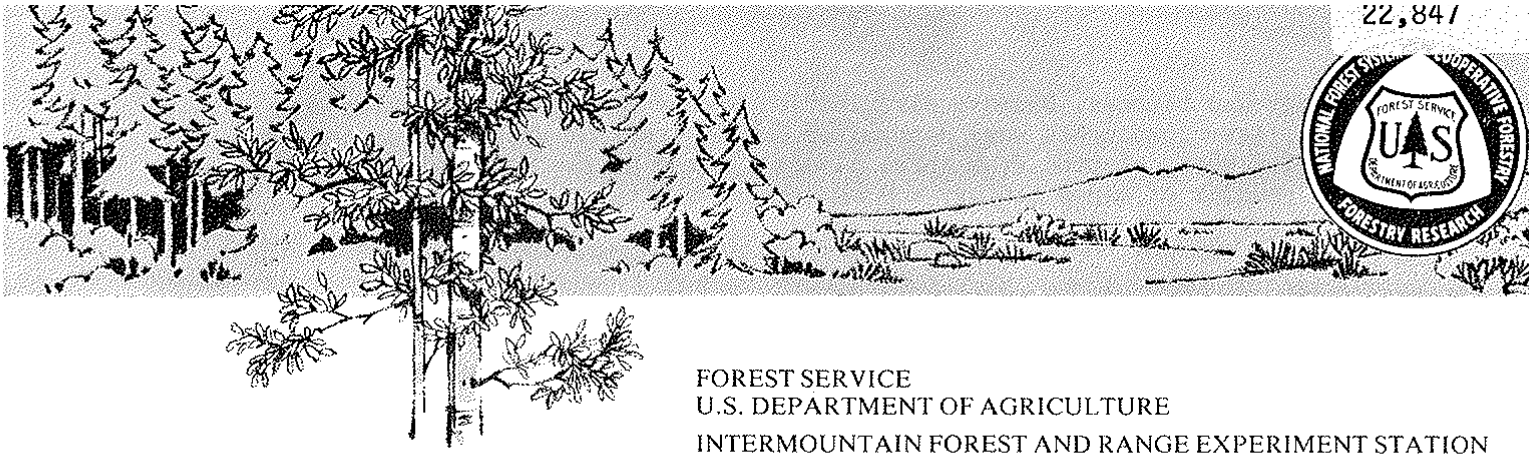
D.L. Bartos



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SUMMARY OF NUTRIENT AND BIOMASS DATA FROM TWO ASPEN SITES IN WESTERN UNITED STATES

Robert S. Johnston and Dale L. Bartos[1]

ABSTRACT

*Summary tables are presented for aboveground biomass and nutrient concentrations for 20 aspen trees (*Populus tremuloides *Michx.) that were sampled at two study sites in Utah and Wyoming. Trees were divided into seven components--leaves, current twigs, old twigs, deadwood (branches), branches, bark, and bole wood. Samples from each component were analyzed for nitrogen, phosphorus, potassium, calcium, sodium, magnesium, zinc, iron, and percent ash.*

KEYWORDS: nutrient concentration, biomass, aspen, *Populus tremuloides*

This paper presents a compilation of aboveground biomass measurements and nutrient concentrations of three clones of aspen (*Populus tremuloides* Michx.) sampled at two study sites in Utah and Wyoming. The study is part of a comprehensive research program to investigate the dynamics and functioning of the aspen ecosystem.

Aspen has been studied extensively in the eastern United States and other parts of the world, but little work has been done on the aspen of the western United States. The current research program includes the development of a predictive model of ecosystem dynamics (Bartos 1973). Because of the lack of data, many relationships were developed by using records from other areas. The data reported in this paper were collected to validate and improve the model to make it more applicable to this region.

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[1] The authors are, respectively, Research Hydrologist and Range Scientist, located at the Intermountain Station's Forestry Sciences Laboratory, Logan, Utah.

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Aboveground biomass, biomass distribution within each tree, and major nutrients in the various tree components were determined for 20 trees of varying size and age. The trees sampled were selected from three clones located at two sites where multidisciplinary studies of aspen ecology and management are being conducted.

SITE DESCRIPTION AND METHODS

The Chicken Creek site is located at 2,400 m elevation on the Davis County Experimental Watershed, approximately 24 km northeast of Salt Lake City, Utah. The other site, Gros Ventre, is located at 2,300 m elevation on the Bridger-Teton National Forest, approximately 48 km northeast of Jackson, Wyoming. Vegetation, soils, and topography of the Chicken Creek site were described by Johnston and Doty (1972). Vegetation and topography of the Gros Ventre site were discussed by Krebill (1972) and the soils by Bare (1972).

Individual clones at each site were identified by their phenotypic characteristics. The tree samples represented the variation in size classes within the three clones.

Fourteen trees from two Chicken Creek clones were sampled in 1973. These clones are designated Chicken Creek 3 and 4. Trees ranged in age from 16 to 91 years; the mean age of trees in each clone was about 48 years. Tree heights ranged from about 4 to 18 m and diameter at breast height (d.b.h.) from 3 to 27 cm.

The six trees sampled at the Gros Ventre site in 1974 were older, ranging in age from 94 to 151 years (average age, 116 years). Tree height ranged from 6 to 20 m and d.b.h. from 14 to 36 cm.

A total tree harvest method was used to arrive at aboveground biomass. Trees were harvested in August to make certain that maximum growth had been attained. Diameter at breast height, age, and height of each tree were recorded. If the bole was divided into manageable sections, additional diameter measurements were taken at the midpoint of each section.

Trees were felled and divided into seven components (within-tree biomass)--leaves, current twigs, old twigs, branches, deadwood, bark, and bole. A "current twig" was considered to be one with leaves and an "old twig" was defined as that portion from the bud scale scars of current growth back to the previous twig. All components were weighed in the field to determine the green weight. Each part was then subsampled to determine percent dry matter for conversion to dry weights. These subsamples were ovendried at 70° C for at least 48 hours for leaves and twigs and 336 hours, or until a constant weight occurred, for wood and bark.

Initially, 100 percent of the leaves, current twigs, and old twigs from several trees were separated in the field. After this, a small portion of the total twig and leaf components was sampled to conserve time. The calculated percentages were used to convert the total weight into appropriate parts.

Two hundred leaves were randomly selected from each tree to determine leaf area using a Lambda portable area meter. The total tree leaf area was then obtained by multiplying the mean leaf area by the calculated number of leaves per tree (total leaf weight divided by the average leaf weight).

All dried samples from the various tree parts were ground to pass through a 20-mesh screen and then subsampled for nutrient determinations. Each sample was analyzed for total nitrogen by the Kjeldahl method, phosphorus, potassium, calcium, sodium, magnesium, zinc, iron, and percent ash on a dry weight basis. Metals were analyzed by atomic absorption techniques, but other elements were analyzed according to Chapman and Pratt (1961). All determinations were made in the Soils Laboratory at Utah State University, Logan, Utah.

RESULTS

Biomass Distribution

Appendix table 1 summarizes individual tree characteristics, and related biomass measurements.

Graphical presentation of the distribution of aspen tree biomass among the seven components for each of the clones is shown in figure 1. These data are expressed as a

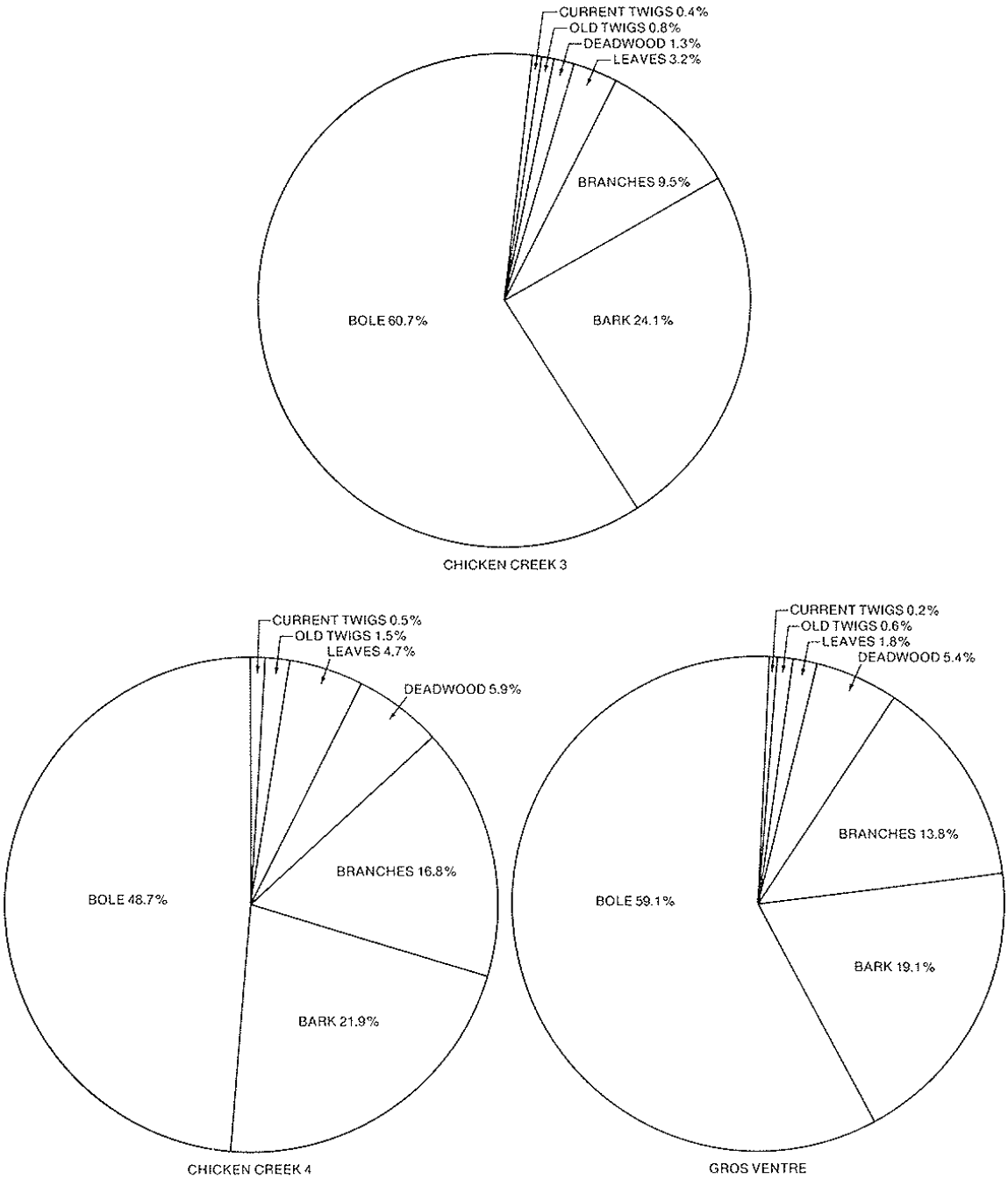

Figure 1.--Distribution of aspen tree biomass among seven components expressed as a percentage of the total weight.

percentage of total weight. The major portion of aboveground biomass is contained in the bole, the next largest portion in the bark, and the third largest in the branches. Leaves and current growth average 4 percent of the biomass.

Equations were developed to show the relationship between d.b.h. and total aboveground biomass for each of the study areas (fig. 2). The R^2 values were 0.997 for each curve. A single equation was developed for the Chicken Creek area by using pooled data from the two clones.

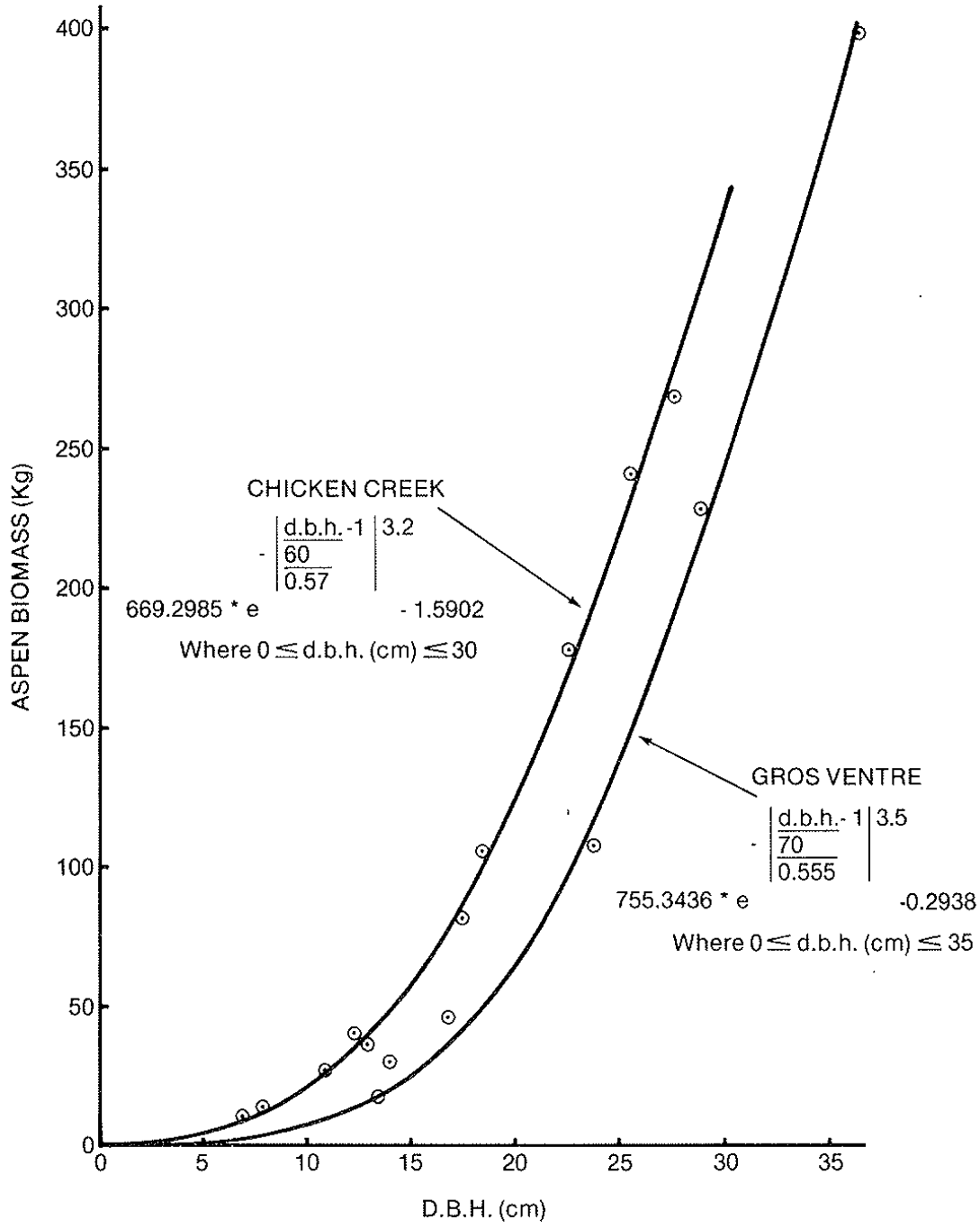

Figure 2.--Original data, predictive equation, and fitted curve for total aspen biomass for Chicken Creek and Gros Ventre Study sites.

Nutrient Analyses

All nutrient analyses for the 20 trees are summarized in appendix tables 2-8. Each table lists nutrient concentrations of each tree for a single component part. Nutrient concentrations in the bark and bole components of small trees are listed as a single entry. In large trees, these components were divided into several sections and the nutrient concentration of each section is presented.

Total content of each element per tree or component can be derived by multiplying the elemental concentration by the corresponding dry weight of the component to provide a weighted value.

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APPENDIX

Table 1.--*Summary of individual tree characteristics and related biomass measurements*

Tree No.	D.B.H.	Height	Age at d.b.h.	Leaf area	Leaves	Current twigs	Old twigs	Branch	Dead wood	Bark	Bole	Weight total
	cm	*m*		*cm²*			*kg*					
					Chicken Creek 3							
1	7.9	8.6	27	53,116	0.416	0.034	0.162	1.404	0.150	3.503	8.555	14.224
2	10.9	10.4	30	132,096	1.197	.078	.260	3.240	.202	7.056	14.319	27.352
3	3.3	4.0	25	6,277	.048	.003	.019	.058	.007	.468	1.146	1.749
4	3.0	4.8	16	19,608	.129	.031	.015	.095	.073	.371	.957	1.671
5	27.4	17.1	91	344,802	4.466	.330	1.266	39.840	5.088	61.627	157.028	269.645
6	18.3	16.0	71	89,308	1.170	.113	.235	8.880	.564	25.690	68.719	105.371
11	22.3	17.7	71	330,476	3.662	.264	(2)	22.021	.846	39.882	111.846	178.521
					Chicken Creek 4							
7	25.4	11	88	--	4.494	.507	1.120	55.220	35.250	46.262	99.173	242.03
8	17.3	8.5	60	196,803	1.641	.198	.516	16.128	6.080	19.130	38.546	82.24
9	12.7	8.6	50	--	←---------2.001---------→			5.170	2.280	8.827	18.316	36.60
10	12.2	8.7	51	188,729	1.425	.174	.624	6.985	2.426	8.613	20.524	40.77
12	3.8	3.8	29	23,820	.168	.015	.058	.217	.133	.609	1.390	2.59
13	6.9	5.8	31	51,615	.782	.103	.260	1.925	.079	1.982	5.589	10.72
14	4.3	3.8	29	29,463	.240	.017	.053	.560	.053	.787	1.514	3.22
					Gros Ventre							
1	23.6	10.4	[1]167 (200)	332,866	2.440	.200	.758	25.264	5.202	22.490	51.033	107.39
2	28.7	16.0	104	329,140	3.158	.501	1.732	26.827	5.090	39.650	151.507	228.46
3	16.8	11.7	99	92,418	.741	.063	.235	4.104	2.108	8.828	29.364	45.44
4	36.0	20.4	143	459,178	3.547	.876	1.392	72.620	18.295	64.647	238.365	399.74
5	14.0	12.0	71 (100)	82,398	.568	.070	.266	3.440	2.858	4.168	19.134	30.50
6	13.5	6.3	30 (80)	54,007	.449	.046	.104	1.651	1.220	4.849	9.526	17.84

[1] Age to heartrot - estimated age in parentheses.

[2] Old twigs included with branches on tree 11.

Table 2.--*Nutrient concentration for the leaf component for 20 aspen trees*

Tree No.	N	P	Na	K	Ca	Mg	Fe	Zn	Ash
				µg/g					*%*
				Chicken Creek 3					
1	25,250	1,500	36	9,850	10,750	2,700	77.5	180	5.58
2	23,850	1,700	37.5	9,750	13,050	2,500	62.5	148.5	5.78
3	25,000	1,650	44.5	9,350	14,800	3,200	80	99.5	5.99
4	27,750	2,500	38.5	10,100	14,500	2,950	90	165	6.45
5	23,400	1,400	49	7,900	10,550	2,250	100	122.5	5.00
6	21,250	1,350	42	9,700	10,300	2,100	165	89	5.41
11	23,050	1,550	43.5	9,050	10,800	2,400	157.5	97	5.27
				Chicken Creek 4					
7	23,700	1,650	46	10,600	11,650	2,100	100	60	5.76
8	23,400	1,550	46.5	9,900	11,950	2,300	65	71.5	5.57
9	--	--	--	--	--	--	--	--	--
10	23,900	1,500	45.5	11,200	11,400	2,150	107.5	60.5	5.74
12	22,300	1,500	65.5	9,600	13,000	3,150	125	63.5	6.15
13	23,900	1,700	49.5	10,050	13,250	2,450	172.5	65	6.47
14	20,500	1,700	60	15,450	11,400	1,950	115	66	6.86
				Gros Ventre					
1	24,650	1,950	26	9,200	9,850	3,300	51.5	90.5	5.10
2	26,250	2,200	27	15,250	8,050	1,750	68.5	77.5	5.67
3	26,850	2,200	23	13,450	9,250	2,950	52	80.5	5.74
4	29,000	2,300	23.5	18,500	12,550	2,500	72.5	115	7.43
5	30,250	2,450	39	18,850	13,300	3,250	66	141	8.31
6	26,000	2,100	21	15,350	9,350	2,050	71.5	101	5.79

Table 3.--*Nutrient concentration for the current twig component for 20 aspen trees*

Tree No.	N	P	Na	K	Ca	Mg	Fe	Zn	Ash
	µg/g								%
				Chicken Creek 3					
1	11,900	1,650	50.5	6,650	12,050	2,450	34.5	156.5	5.07
2	11,450	1,600	54.5	5,600	13,700	1,900	33	121.5	5.15
3*	11,150	1,600	41.5	6,900	10,050	1,800	37.5	96	4.26
4*	11,150	1,600	41.5	6,900	10,050	1,800	37.5	96	4.26
5	11,350	1,500	53	5,650	12,950	2,050	44.5	129.5	4.50
6	12,100	1,550	52	5,850	12,350	1,900	78	85.5	4.90
11	11,400	1,700	42	5,400	13,700	2,150	47	95	5.18
				Chicken Creek 4					
7	10,700	2,050	60	6,400	11,950	2,100	53.5	82	4.89
8	10,900	1,850	53	6,400	11,750	2,250	48.5	94	4.67
9	--	--	--	--	--	--	--	--	--
10	10,750	1,750	61	6,800	13,350	2,350	46	85.5	5.17
12	11,100	2,350	68.5	6,850	11,150	3,100	48	88	4.72
13	9,950	1,850	55.5	6,050	12,150	2,300	63.5	83	4.75
14	11,300	2,350	66	7,750	13,750	2,500	55	96	4.75
				Gros Ventre					
1	10,300	1,800	34	5,400	10,050	1,900	29.5	92	3.93
2	9,900	2,000	44	6,450	9,100	1,050	38	73	4.04
3	11,800	2,150	43	6,600	9,650	2,200	30.5	91	4.15
4	10,650	2,000	24	8,450	8,700	1,200	37.5	73	4.15
5	13,400	2,600	28	9,400	10,400	1,550	28.5	90	4.92
6	9,350	2,000	39	7,950	10,650	1,450	60.5	108	4.70

* Trees 3 and 4 were combined for nutrient analysis.

Table 4.--*Nutrient concentration for the old twig component for 20 aspen trees*

Tree No.	N	P	Na	K	Ca	Mg	Fe	Zn	Ash
	µg/g								%
				Chicken Creek 3					
1	7,000	750	75	4,750	14,600	1,450	35	135.5	5.00
2	6,950	900	75.5	4,150	18,450	1,300	27.5	112	5.94
3*	6,600	800	64	3,800	16,250	1,300	35	97.5	5.24
4*	6,600	800	64	3,800	16,250	1,300	35	97.5	5.24
5	7,250	800	84	4,650	15,000	1,250	47	110	5.03
6	8,050	900	72	4,750	14,650	1,300	51	77	5.23
11	--	--	--	--	--	--	--	--	--
				Chicken Creek 4					
7	8,100	1,300	52	5,150	10,850	1,350	36	66	4.17
8	7,700	1,250	46	4,900	11,150	1,700	39.5	65.5	4.26
9	--	--	--	--	--	--	--	--	--
10	7,600	1,050	56	5,000	12,950	1,700	35.5	61	4.78
12	7,550	1,250	58	5,100	10,350	2,150	30.5	55.5	3.58
13	7,050	1,300	43	4,450	11,600	1,700	34.5	53	4.07
14	7,750	1,400	47	5,500	10,800	1,550	55	66.5	3.54
				Gros Ventre					
1	5,700	1,000	37	4,700	9,950	1,350	42.5	92.5	3.78
2	5,900	900	45.5	5,750	11,450	750	54	78.5	4.27
3	6,600	1,250	40	6,000	9,150	1,250	49	89.5	3.75
4	7,000	1,300	40	6,750	8,450	900	31	76.5	3.79
5	7,600	1,350	60	6,750	9,850	1,200	42	87.5	4.16
6	6,850	1,250	48	7,200	10,400	1,100	46	83	4.28

* Trees 3 and 4 were combined for nutrient analysis.

Table 5.--*Nutrient concentration for the branch component for 20 aspen trees*

Tree No.	N	P	Na	K	Ca	Mg	Fe	Zn	Ash
				µg					%
				Chicken Creek 3					
1	5,050	600	51	3,050	14,850	1,150	34	119	4.72
2	5,150	650	46.5	2,650	16,050	1,050	32.5	122.5	4.97
3*	6,050	850	66	3,250	16,100	1,350	30.5	94.5	5.10
4*	6,050	850	66	3,250	16,100	1,350	30.5	94.5	5.10
5	5,150	550	55	3,000	16,650	1,000	28	115	4.04
6	5,600	500	54.5	3,000	20,300	1,000	30.5	84	6.17
11	5,100	550	55.5	2,600	17,150	1,000	21.5	85	5.33
				Chicken Creek 4					
7	5,900	700	77	3,050	13,000	1,100	15	76.5	4.31
8	5,700	700	99	3,200	17,450	1,450	29.5	78	4.78
9	--	--	--	--	--	--	--	--	--
10	5,900	700	64	3,650	14,500	1,400	22	63	4.65
12	5,700	700	67	3,000	13,900	1,700	17	55	4.41
13	5,050	650	58.5	2,650	16,800	1,500	54	69.5	5.17
14	5,950	750	75.5	3,300	15,950	1,400	27.5	68	4.98
				Gros Ventre					
1	3,700	700	26	2,650	9,900	1,050	42.5	78	3.50
2	4,850	650	22	3,700	10,950	650	19	75.5	3.63
3	3,950	750	27	2,800	8,800	1,050	38.5	80	3.30
4	4,600	800	26	3,700	8,450	800	21	78.5	2.98
5	3,750	600	22.5	2,800	11,450	1,150	20.5	86	3.58
6	4,350	650	37	3,650	11,000	900	30	84	3.77

* Trees 3 and 4 were combined for nutrient analysis.

Table 6.--*Nutrient concentration for the dead wood component for 20 aspen trees*

Tree No.	N	P	Na	K	Ca	Mg	Fe	Zn	Ash
				µg					%
				Chicken Creek 3					
1	4,600	200	134	1,400	15,450	850	154	114.5	4.89
2	4,300	550	96.5	2,650	20,700	1,200	55	113	6.54
3*	4,400	200	68.5	1,900	11,800	900	30.5	75.5	3.70
4*	4,400	200	68.5	1,900	11,800	900	30.5	75.5	3.70
5	3,700	150	132.5	950	16,400	700	78	93.5	4.77
6	3,850	200	84	1,750	11,950	500	36.5	86	2.68
11	3,400	100	79.5	1,500	19,300	750	36	74	4.76
				Chicken Creek 4					
7	4,300	150	86	750	13,850	700	178	64	4.25
8	4,300	200	80	750	11,450	650	193	62.5	3.50
9	--	--	--	--	--	--	--	--	--
10	4,100	100	81	500	10,250	500	195	60	3.17
12	4,600	200	92	1,050	13,900	1,000	129.5	55	3.29
13	6,100	400	153.5	2,200	16,400	1,100	46	50	4.96
14	4,550	100	71.5	450	9,750	450	106	45.5	2.84
				Gros Ventre					
1	3,100	200	57	950	12,700	850	85	89	3.96
2	2,950	250	49	1,000	8,450	500	139	65.5	2.74
3	3,000	250	57	500	4,850	450	314	47	2.10
4	2,900	200	45.5	700	6,800	550	192.5	57.5	2.35
5	2,600	200	64.5	600	5,800	550	116.5	54	2.13
6	3,050	200	64	1,100	7,600	500	147	64	2.60

* Trees 3 and 4 were combined for nutrient analysis.

Table 7.--*Nutrient concentration for the bole component by section for 20 aspen trees*

Tree No.	Section	N	P	Na	K	Ca	Mg	Fe	Zn	Ash
	cm				µg/g					%
					Chicken Creek 3					
1	2.8	1,600	200	50.5	1,400	850	300	19	26	0.49
	6.4	1,200	100	50	850	800	300	137.5	30.5	.32
	9.1	1,100	100	44	3,350	3,250	750	14.5	25	1.58
	$\bar{x}$	1,300	133	48	1,867	1,633	450	57	27	.80
2	*	1,100	100	29.5	700	600	200	21	14.5	.25
	$\bar{x}$	1,100	100	29.5	700	600	200	21	14.5	.25
3	*	1,250	100	38.5	750	850	200	19	14.5	.35
	$\bar{x}$	1,250	100	38.5	750	850	200	19	14.5	.35
4	*	1,400	200	24	950	600	200	65.5	18.5	.32
	$\bar{x}$	1,400	200	24	950	600	200	65.5	18.5	.32
5	2.5	1,750	200	36	1,000	1,400	300	70	31	.64
	7.9	1,200	100	24	900	1,200	250	23	17.5	.45
	15.5	1,150	100	15.5	1,850	2,400	500	24	24	.84
	20.3	1,050	100	28.5	750	900	250	21.5	14.5	.28
	27.4	1,000	65	11.0	500	1,500	200	24	17.5	.37
	$\bar{x}$	1,230	113	23	1,000	1,480	300	33	21	.52
6	6.1	1,450	150	73.5	1,750	850	300	36	14	.58
	15.8	1,100	100	34.5	1,550	1,750	400	20	13.5	.71
	19.3	900	45	20.5	650	1,100	200	18	12.5	.49
	$\bar{x}$	1,150	98	43	1,317	1,233	300	25	13	.59
11	8.8	1,200	150	17	800	1,050	200	30	12.5	.51
	14.4	1,000	100	11	600	1,050	200	15.5	9.5	.36
	23.4	800	100	33.5	450	450	150	17.5	9	.18
	$\bar{x}$	1,000	117	21	617	850	183	21	10	.35
					Chicken Creek 4					
7	3.3	3,250	550	35	1,500	3,950	400	41.5	32.5	1.50
	8.8	1,600	200	15.5	900	1,300	200	26.5	11	.50
	18.2	1,250	100	14	1,400	1,100	300	28	11	.54
	26.0	1,200	100	14	950	1,450	250	16.5	12	.43
	$\bar{x}$	1,825	238	20	1,188	1,950	313	28	17	.74
8	4.1	1,850	450	110.5	1,150	1,550	400	27.5	15	.53
	6.7	1,500	200	70.5	1,000	1,050	300	25	11.5	.53
	13.0	1,300	200	32.5	1,700	2,050	450	20	15	.74
	18.2	1,350	100	44.5	1,450	1,800	400	23	14.5	.77
	$\bar{x}$	1,500	238	65	1,325	1,613	388	24	14	.64
9	3.6	1,550	300	20.5	1,000	1,100	300	30.5	27	.50
	10.0	1,350	150	18.5	850	1,400	250	21.5	13.5	.41
	14.9	1,250	100	14.5	1,000	1,150	250	21.5	12	.49
	$\bar{x}$	1,383	183	18	950	1,217	267	25	18	.47
10	5.7	1,500	300	31.5	1,100	1,000	300	50	13.5	.45
	9.1	1,400	200	33	1,350	1,000	300	29	14	.55
	14.0	1,200	100	21.5	600	550	150	27.5	9.5	.27
	$\bar{x}$	1,367	200	29	1,017	850	250	36	12	.42
12	2.1	1,100	300	41.5	1,050	1,200	400	107.5	17	.90
	3.4	1,400	300	36.5	950	1,000	300	77.5	11	.54
	5.7	1,250	200	29.5	600	450	200	40.5	17.5	.22
	$\bar{x}$	1,250	267	36	867	883	300	75	15	.55
13	3.2	1,550	450	102	1,100	650	300	30	15.5	0.41
	5.7	1,300	200	38.5	700	700	250	41.5	11.0	.44
	7.8	1,250	200	76	750	350	200	42.5	10	.26
	$\bar{x}$	1,367	283	72	850	567	250	38	12	.37
14	2.7	2,300	400	20.5	1,450	500	350	71	17.5	.55
	3.6	1,200	250	17	900	950	250	70	11.5	.41
	5.8	1,650	200	18.5	750	700	150	59	11.5	.40
	$\bar{x}$	1,717	283	19	1,033	717	250	67	14	.45

(con.)

Table 7.--*(con.)*

Tree No.	Section	N	P	Na	K	Ca	Mg	Fe	Zn	Ash
	cm				µg/g					%
					Gros Ventre					
1	4.3	1,650	150	28	950	1,450	350	110	18.5	0.66
	6.4	1,250	<100	30	400	1,100	200	<4	10	.40
	13.2	1,100	100	50	500	950	300	10.5	9.5	.39
	17.5	1,150	<100	24	350	1,150	300	10.5	10.5	.41
	17.5	900	150	44	500	1,150	300	20.5	10	.37
	18.8	1,200	<100	19	750	1,250	350	8.5	10.5	.45
	25.7	1,000	<100	22	350	750	200	4.5	9.5	.31
	$\bar{x}$	1,179	114	31	543	1,114	286	24	11	.43
2	8.4	1,150	100	28	600	1,050	250	4.5	15	.46
	17.3	1,000	<100	17	500	1,200	200	18.5	12	.46
	21.6	750	<100	25	400	1,000	200	7.5	12.5	.38
	26.4	700	<100	23	300	1,000	200	6.5	11.5	.38
	31.2	1,000	<100	38	450	750	100	15.5	12.5	.33
	$\bar{x}$	920	100	26	450	1,000	190	11	13	.40
3	7.1	1,300	100	43	750	1,150	300	16	12.5	.52
	9.4	1,150	<100	26	500	1,050	300	5.5	11.5	.45
	11.7	1,000	<100	40	350	1,150	300	17.5	9	.42
	13.2	850	<100	18	450	1,000	300	4.5	10	.40
	16.5	950	<100	13	950	1,000	250	4	7	.31
	$\bar{x}$	1,050	100	28	600	1,070	290	10	10	.42
4	11.2	1,250	200	23	850	1,150	300	17.5	11	.55
	20.8	1,000	<100	51	550	1,150	200	8	12.5	.47
	26.7	900	100	10	650	1,250	300	9	10	.40
	27.7	850	<100	24	450	1,300	300	24.5	12	.54
	30.2	800	<100	15	650	1,450	300	23	14.5	.53
	38.9	900	<100	33	750	1,150	300	10	11	.44
	$\bar{x}$	950	117	26	650	1,242	283	15	12	.49
5	4.1	1,100	200	20	700	1,300	250	11.5	18	0.40
	8.6	850	100	21	400	1,300	300	4.5	14	.48
	10.7	900	<100	58	500	1,350	350	16.5	12.5	.52
	13.2	1,300	150	22	1,250	1,850	500	10	15.5	.78
	$\bar{x}$	1,038	138	30	713	1,450	350	11	15	.55
6	9.8	1,650	200	27	1,450	4,900	900	18.5	26	1.72
	14.5	1,200	<100	14	1,750	4,150	850	7.5	21	1.49
	$\bar{x}$	1,425	150	21	1,600	4,525	875	13	24	1.61

* All sections combined.

Table 8.--*Nutrient concentration for the bark component by section for 20 aspen trees*

Tree No.	Section	N	P	Na	K	Ca	Mg	Fe	Zn	Ash
	cm				*ug/g*					%
					Chicken Creek 3					
1	2.8	7,050	900	31	4,150	16,100	1,300	24	149.5	4.92
	6.4	5,100	650	39	3,150	17,300	1,100	23	167	5.40
	9.1	4,150	300	33	2,150	16,100	700	18	152	4.75
	$\bar{x}$	5,433	617	34	3,150	16,500	1,033	22	156	5.02
2	*	5,150	650	32.5	3,350	13,000	800	27.5	130.5	3.74
	$\bar{x}$	5,150	650	32.5	3,350	13,000	800	27.5	130.5	3.74
3	*	4,650	350	46.5	2,500	21,300	900	28.5	115.5	6.52
	$\bar{x}$	4,650	350	46.5	2,500	21,300	900	28.5	115.5	6.52
4	*	5,400	750	29.5	3,550	14,000	800	30	119	3.49
	$\bar{x}$	5,400	750	29.5	3,550	14,000	800	30	119	3.49
5	2.5	5,700	550	44.5	3,600	19,850	1,000	19	167.5	6.27
	7.9	5,400	450	43.5	2,450	21,100	1,050	14	164.5	5.36
	15.5	4,950	400	17.0	2,100	21,300	900	18	165	4.64
	20.3	4,650	350	21.5	2,150	20,700	850	14.5	171	6.10
	27.4	3,900	300	59.5	2,000	17,700	600	17.5	140.5	5.25
	$\bar{x}$	4,920	410	37	2,460	20,130	880	17	162	5.52
6	6.1	4,450	300	37	3,400	20,800	950	18	120.5	6.39
	15.8	4,400	300	52.5	2,550	20,550	750	22	129.5	6.35
	19.3	4,000	300	37	2,050	17,000	600	31.5	106.5	5.18
	$\bar{x}$	4,283	300	42	2,667	19,450	767	24	119	5.97
11	8.8	5,150	450	27.5	2,350	17,100	1,050	25.5	133	4.96
	14.4	4,950	450	27.5	2,450	17,400	900	84	132.5	5.23
	23.4	4,000	300	33	2,500	16,650	600	24	121	4.35
	$\bar{x}$	4,700	400	29	2,433	17,050	850	45	129	4.85
					Chicken Creek 4					
7	3.3	6,550	750	50	3,800	13,650	1,100	33	107	4.41
	8.8	5,850	550	37	2,450	15,850	1,300	14.5	121	4.55
	18.2	5,350	500	34.5	2,350	15,600	1,250	20.5	124	4.74
	26.0	5,350	450	38.5	2,500	16,100	1,200	16	137	5.01
	$\bar{x}$	5,775	563	40	2,775	15,300	1,213	21	122	4.68
8	4.1	6,100	850	49	3,200	19,600	1,800	13	149	6.39
	6.7	5,800	600	39	2,650	18,800	1,700	23	142	5.83
	13.0	4,800	400	42	1,950	18,750	1,400	28	121	5.59
	18.2	4,250	350	42.5	2,400	17,050	1,050	13.5	109.5	5.16
	$\bar{x}$	5,238	550	43	2,550	18,550	1,488	19	130	5.47
9	3.6	6,350	800	42	4,100	13,950	1,500	29.5	139	4.66
	10.0	4,950	500	74.5	2,200	15,300	1,200	22	126.5	4.59
	14.9	4,550	400	47	2,650	14,950	1,100	13	104.5	4.55
	$\bar{x}$	5,283	567	55	2,983	14,733	1,267	22	123	4.60
10	5.7	5,600	500	26.5	2,400	15,300	1,600	24	106.5	4.79
	9.1	6,350	750	38.5	3,150	14,050	1,450	16.5	126.5	4.63
	14.0	4,450	300	55.5	2,400	15,500	1,000	14	97	4.53
	$\bar{x}$	5,467	517	40	2,650	14,950	1,350	18	110	4.65
12	2.1	9,100	950	125	3,400	18,250	2,000	24	106	5.85
	3.4	5,700	650	57	3,200	16,950	1,600	22	113.5	5.56
	5.7	4,850	500	46	2,400	16,250	1,150	72	100.5	5.03
	$\bar{x}$	6,550	700	76	3,000	17,150	1,583	39	107	5.48
13	3.2	7,600	700	162.5	3,650	15,000	1,700	24.5	121.5	4.79
	5.7	6,600	700	87	2,900	15,000	1,450	78	373	4.56
	7.8	4,100	400	42	2,450	15,200	900	13	101.5	4.48
	$\bar{x}$	6,100	600	97	3,000	15,067	1,350	39	199	4.61
14	2.7	11,000	950	91	4,200	17,250	1,650	78	143	4.40
	3.6	7,000	650	64	3,300	19,050	1,600	80	135	4.48
	5.8	5,000	500	45	2,400	16,450	1,100	58.5	109	4.84
	$\bar{x}$	7,667	700	57	3,300	17,583	1,450	72	129	4.57

(con.)

Table 8.--*(con.)*

Tree No.	Section	N	P	Na	K	Ca	Mg	Fe	Zn	Ash
	cm				*µg/g*					*%*
					Gros Ventre					
	4.3	4,300	700	26	2,650	20,850	1,500	20.5	168.5	6.31
	6.4	4,050	450	26.5	2,200	23,750	1,300	14	158.5	6.95
	13.2	3,750	500	21.5	2,250	15,950	1,400	19	130.5	5.03
1	17.5	3,900	500	25	2,350	14,100	1,400	9.5	141	5.17
	17.5	3,850	500	23.5	2,150	17,250	1,350	22.5	160	5.44
	18.8	3,400	450	17	3,000	19,300	1,250	24.5	130	6.73
	25.7	3,800	800	20.5	4,800	12,050	1,400	28.5	108.5	5.16
	$\bar{x}$	3,864	557	23	2,771	17,607	1,371	20	142	5.83
	8.4	5,950	700	26.5	3,400	8,450	900	17	131	2.90
	17.3	5,850	650	19	2,950	10,500	1,050	21	143.4	3.63
2	21.6	4,900	550	21	2,900	11,300	1,050	16	140	3.85
	26.4	4,050	600	24	3,150	12,450	900	26	136.5	4.06
	31.2	4,300	750	29	5,350	13,150	900	38.5	124	4.78
	$\bar{x}$	5,010	650	24	3,550	11,170	960	24	135	3.84
	7.1	4,600	600	18	3,000	16,650	1,500	14.5	134.5	5.51
	9.4	3,950	500	36	2,150	14,850	1,500	34	139.5	5.56
3	11.7	3,650	500	23	2,200	15,950	1,400	13.5	147.5	5.73
	13.2	3,300	350	22	1,750	20,500	1,300	13	146.5	6.05
	16.5	3,200	600	36	2,650	13,550	1,400	16	115	5.15
	$\bar{x}$	3,740	510	27	2,350	16,300	1,420	18	137	5.60
	11.2	5,700	750	19	3,350	10,250	900	20	117.5	3.51
	20.8	5,550	750	123.5	3,250	10,550	1,250	14	131	3.77
	26.7	5,600	750	20.5	3,450	12,950	1,550	15	144	4.64
4	27.7	4,650	650	106	3,300	12,350	1,400	32	138	4.34
	30.2	4,700	600	28	2,850	13,050	1,650	16	145.5	4.35
	38.9	4,550	750	31	5,000	11,700	1,900	23	121	4.94
	$\bar{x}$	5,125	708	55	3,533	11,808	1,442	20	133	4.26
	4.1	5,000	1,000	27	3,650	17,550	1,600	56	158	5.72
	8.6	4,750	800	26	3,000	17,100	2,200	36	183	5.47
5	10.7	4,150	600	22.5	2,650	16,800	1,950	33.5	177.5	5.60
	13.2	5,000	750	23	3,250	16,700	4,150	36.5	140	5.75
	$\bar{x}$	4,725	788	25	3,178	17,038	2,475	41	165	5.64
	9.8	5,000	500	19.5	3,050	13,900	1,100	16	181.5	4.89
6	14.5	4,100	500	25	3,850	17,050	1,000	22	167.5	5.39
	$\bar{x}$	4,550	500	22	3,450	15,475	1,050	19	175	5.14

* All sections combined.

Headquarters for the Intermountain Forest and Range Experiment Station are in Ogden, Utah. Field programs and research work units are maintained in:

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