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HABITAT IMPROVEMENT THROUGH BRUSH CONTROL ON SHEEP WINTER RANGE, FARO, YUKON

R.E. Schweinsburg

(Revised by M. Gamberg)

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Director, Fish and Wildlife Branch

Supervisor

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ABSTRACT

Heavy aspen regeneration is threatening the habitat quality of the winter range of a small herd of Fannin sheep near Faro, Yukon. This experiment is designed to test burning and the use of herbicide as effective methods of brush control in order to improve habitat for sheep in this area.

ACKNOWLEDGEMENTS

I would like to thank the survey crew, Gloria Cable, Jock and Kelley, and the slashing crew, Jack Caesar, Robert Edsel and William for their hard work. Catherine Kennedy gave her time to identify plants as did Rob Johansen. Ed Foreman weighed the samples and Manfred Hoefs organized the project.

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INTRODUCTION

The encroachment of aspen (*Populus* sp.) and other woody plants onto sheep winter range in the Yukon is of concern to wildlife managers. Sheep are primarily grazers, feeding on grasses and forbs, although some browse (eg. *Salix* sp.) is taken in significant amounts (Hoefs and Cowan 1979). Woody plants outcompete the low-growing vegetation required by sheep as forage, reducing habitat quality, especially on critical winter range.

Sheep mountain, near Faro, Yukon, is the traditional winter range of a small herd of Stone Sheep (*Ovis dalli stonei*), locally known as Fannin sheep. A burn in the region in 1969 resulted in heavy aspen regeneration on the lower slopes and benches of the mountain. This, coupled with a stable sheep population size despite high reproductive success (Schweinsburg 1990), suggests that habitat improvement may encourage population growth. This site is currently being developed as a wildlife-viewing area, and population growth is considered desirable for this purpose.

Burning and/or the use of herbicide have been suggested as potential methods of reducing aspen growth and improving forage quality for sheep (Schweinsburg 1991). This experiment was designed to test the effectiveness of these methods as habitat improvement techniques on the winter range at Faro.

STUDY AREA

The experimental area was an escarpment, locally known as 'South Bluff', on Sheep Mountain, approximately 10 km east of Faro (Fig. 1). This area contains several mineral licks, as well as winter forage, and has traditionally been used by sheep as a winter range. Three major plant communities in the region are of importance to sheep as winter forage. The *Artemisia/Pentstemon* association occurs on open south-facing slopes. The *Rosa/Artemisia/Pontentilla* community occurs at edges of south facing aspen groves, and in low-lying gullies and depressions that collect snow. The Gramineae/*Epilobium* community also occurs at the edge of aspen groves, but those with a northerly aspect. This region was burned in 1969, resulting in downed timber, and dense aspen regeneration on the lower slopes and benches. Brush was slashed in a strip approximately 30 m wide and 1.0 km long at the top of the escarpment in the early winters of 1989 and 1990 as part of a habitat improvement project.

MATERIALS AND METHODS

Sixteen 50 m^2 experimental blocks with 10 m buffer strips surrounding each, were randomly laid out along the top of South Bluff and Lower Bench (Fig. 2). Corners were marked with flagging pyramids, steel rod corner posts, and laths designating plot number and orientation. Attempts were made to locate all blocks within an area homogeneous in vegetation composition and cover. Blocks were relocated if vegetation was unique. All brush on the buffer strips was slashed and piled for future burning, and the buffer strips were subsequently sprayed with herbicide, as described for experimental blocks.

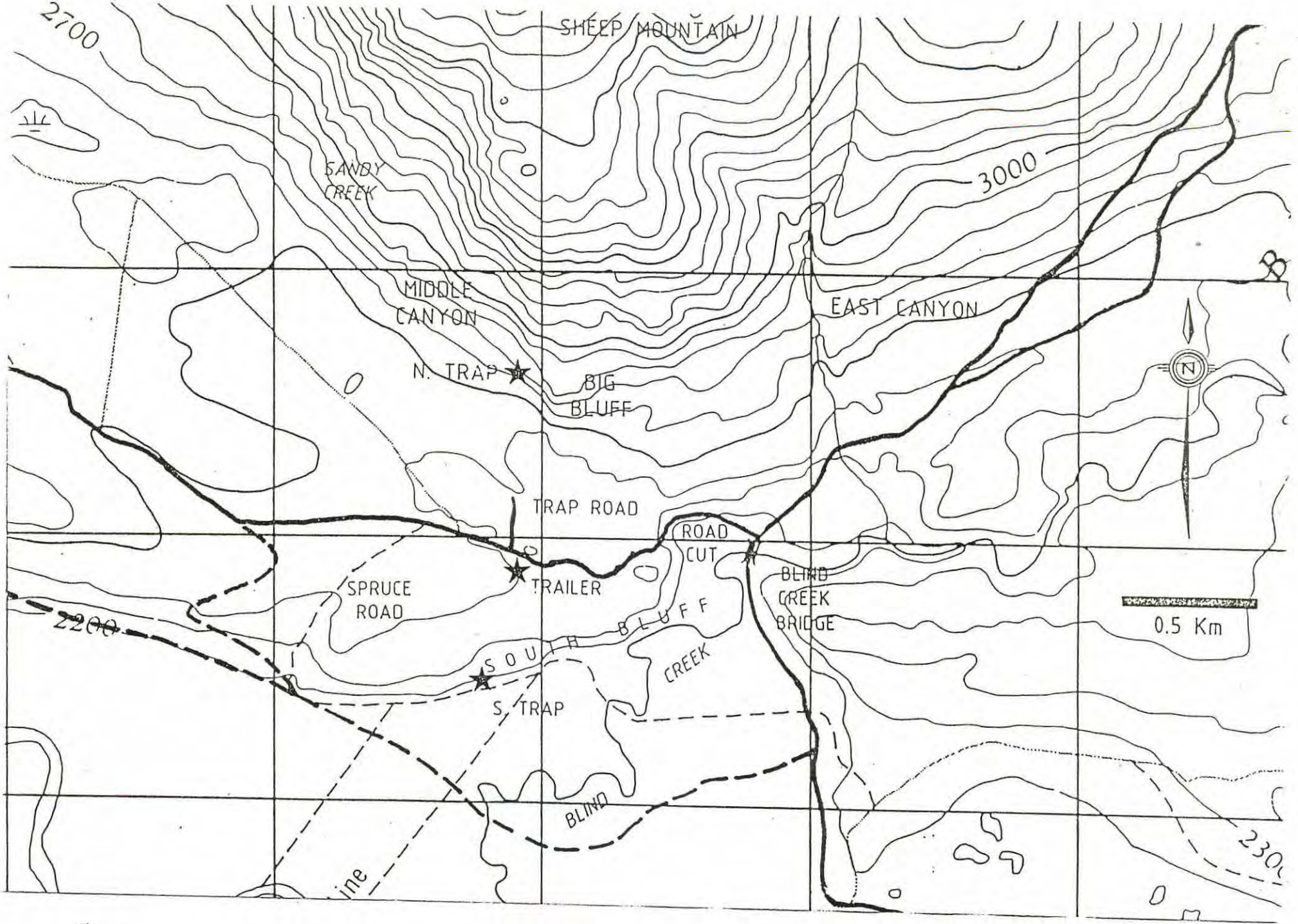

Figure 1. Study area.

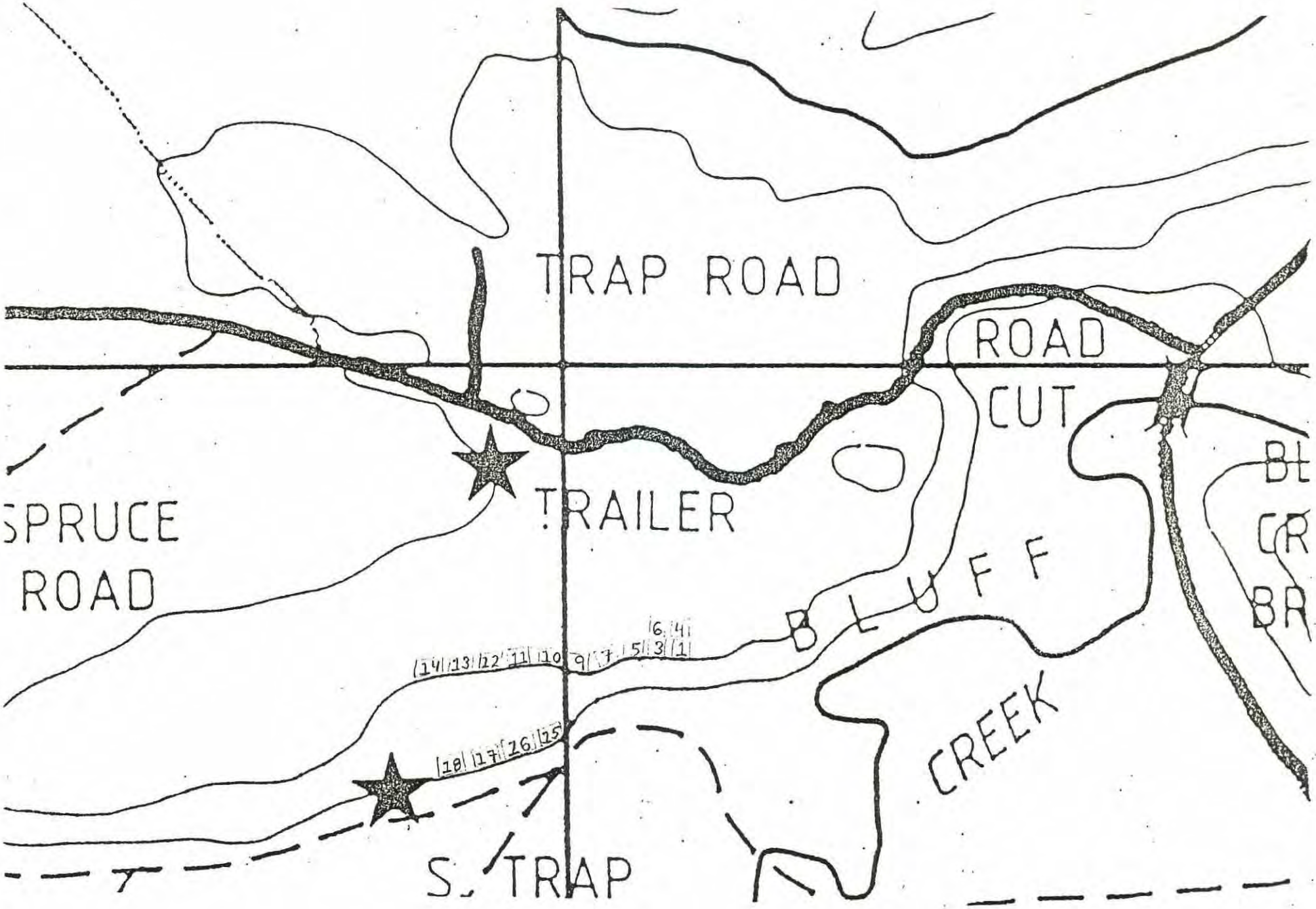

Figure 2. Location of experimental blocks 1-18. Note that blocks 2 and 8 are missing.

Four treatments were designated: control (no treatment), burning, herbicide spraying, burning and herbicide spraying. Four blocks were assigned to each treatment, and deadfall and brush removed from some blocks as outlined in Table 1. Slashing and brush and deadfall removal took place between August 6 and 25, 1991. Note that in some cases, where there was excessive deadfall and brush, piles were made on the blocks rather than buffer strips. Herbicide spraying was carried out by Decora Landscaping (Whitehorse, Yukon) between August 29 and 31, 1991, using a 1.5-2.0% solution of the post-emergent herbicide 'Roundup', a commercial liquid preparation of glyphosate. The concentration of herbicide used is unavailable. amount of solution

Table 1. Experimental treatments

Treatment	Block # [1]	Comments
Control	3, 6, 12, 16	Deadfall and brush removed and piled in buffer strips
Herbicide	1, 9, 14, 18	Deadfall removed and piled in buffer strips; sprayed with herbicide
Burning	4, 5, 11, 15	Deadfall removed and piled in buffer strips; brush cut and left in place for added fuel during burning; scheduled for burning 1992
Herbicide and burning	7, 10, 13, 17	Deadfall removed and piled in buffer strips; brush cut and left in place for added fuel during burning; scheduled for burning and subsequent herbicide spraying in 1992/93

[1] 10 plots were sampled from each block with the following exceptions; 9 plots from blocks 10 and 12; 5 plots from block 18.

Prior to treatment, vegetation on each block was sampled for composition and biomass. Sampling took place between August 6 and 22, 1991. Ten circular plots (2.52 m radius) were randomly established on each block (except as noted in Table 1). Woody plants were sampled by counting every stem in each plot by species, and stems at 1 m height or lower were counted as one even though they may have had a common rootstock. A 1 m^2 block was established at the center of each plot, and every plant clipped, sorted by species and collected for biomass estimation. During sampling, areas of homogeneous *Shepherdia* sp. and *Arctostaphylos* sp. were avoided. Clipped vegetation was air-dried for several weeks, then oven-dried for 24 h before weighing.

Biomass production was compared among treatment groups using a SAS ANOVA procedure on the means of the experimental blocks.

RESULTS AND DISCUSSION

The average biomass of each species encountered when sampling the plots is presented in Table 2. It is apparent from the high standard deviations as compared with the means, that the plots are quite variable for individual species. This is probably attributable to the absence of some species in some plots. Raw data is presented in Appendix 1. The two most common species, *Epilobium* sp. and *Lupinus* sp. were poorly used by Dall sheep (*Ovis dalli dalli*) as forage in the Kluane region of the Yukon (Hoefs and Cowan 1979), but *Calamagrostis* sp. was heavily used, and was found in substantial amounts on the study area. Other species found in some abundance on the study area were *Arctostaphylos* sp. which was heavily used in the spring by the Kluane sheep, and *Astragalus* sp. and *Rosa* sp. which were used to a lesser extent.

Unfortunately, the stem counts of woody plants were lost, so this data is unavailable.

Total primary production averaged 50.20 g/m^2 (SD = 35.82) on the study area and ranged from 25.96 to 80.89 g/m^2. Although the plots were variable , there was no significant difference in biomass production among experimental treatment groups ($p>0.90$). Primary production in this area is substantially less than the average of 67.88 g/m^2 found in the Kluane sheep winter range (Hoefs 1984), but is closer to the average of 55 g/m^2 found for four grassland communities on south-facing slopes in the southern Yukon (Bailey and Willoughby 1990).

Table 2. Primary production in experimental plots. (N=153 1 m^2 plots)

Species	Biomass Mean (g/m^2)	Std. Dev.
Achillea sp.	0.02	0.08
Arctostaphylos sp.	3.53	11.71
Artemisia sp.	0.003	0.04
Aster sp.	0.22	2.53
Astragalus sp.	3.51	9.14
Bromus sp.	3.26	10.51
Calamagrostis sp.	3.42	9.86
Carex sp.	0.10	0.86
Epilobium sp.	13.53	15.91
Festuca sp.	3.51	10.11
Fragaria sp.	0.30	20.8
Gramineae	0.13	1.49
Linnaea borealis	0.47	2.70
Linnaea sp.	0.15	0.84
Lupinus sp.	14.88	27.11
Pyrola sp.	0.08	0.58
Rosa sp.	1.64	7.22
Salix sp.	0.55	4.45
Shepherdia sp.	0.35	2.72
Solidago sp.	0.47	2.04

Recommendations

1) Two additional experimental blocks should be laid out: one with no treatment to use as a control for the deadfall removal and slashing, and one with just deadfall removed to test the effect of slashing.

2) All piled brush on the blocks and buffer zones should be burned.

3) Vegetation should be sampled in August, 1992 on the two new blocks, the blocks sprayed with herbicide in 1991, and on at least some blocks that just had deadfall removed and the brush slashed to determine what effect, if any, it had.

4) Woody stems should be counted on new control blocks to replace lost data, and on at least some blocks that just had deadfall removed and the brush slashed to determine what effect, if any, it had.

5) Designated plots should be burned in fall, 1992, and sprayed with herbicide in 1993.

6) Vegetation should be sampled and woody stems counted from all blocks in 1993 and 1994.

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APPENDIX 1. Primary production for individual plant species, plots and blocks

Table 1. Dry weights (g/m^2) of 10 vegetation samples collected from Block 1.

Species\Plot #	1	2	3	4	5	6	7	8	9	10	Mean	kg/ha
Arctostaphylos sp.	5.65	0.00	17.99	0.00	0.00	0.00	0.00	2.04	0.00	0.00	2.57	25.68
Bromus sp.	0.00	0.00	0.00	0.00	0.00	0.00	4.52	0.00	0.00	0.00	0.45	4.52
Carex sp.	0.00	0.13	0.00	0.00	0.00	1.82	0.00	0.00	0.00	0.00	0.20	1.95
Epilobium sp.	3.94	0.41	38.25	23.26	2.85	1.39	1.94	6.98	1.43	11.51	9.20	91.96
Festuca sp.	0.97	0.00	0.00	0.00	0.00	0.00	0.00	0.98	0.68	0.00	0.26	2.63
Linnaea borealis	0.00	0.00	0.00	16.75	6.19	0.00	0.00	0.00	0.00	3.32	2.63	26.26
Lupinus sp.	0.00	0.00	71.55	14.63	107.58	152.72	1.04	4.73	30.83	6.27	38.93	389.35
Total	10.56	0.54	127.79	54.64	116.62	155.93	7.50	14.73	32.94	21.10	54.24	542.35

Table 2. Dry weights (g/m^2) of 10 vegetation samples collected from Block 3.

Species\Plot #	1	2	3	4	5	6	7	8	9	10	Mean	kg/ha
Arctostaphylos sp.	1.89	0.00	33.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.50	35.02
Calamagrostis sp.	0.45	0.00	0.00	0.00	0.00	0.00	0.00	3.41	0.00	0.00	0.39	3.86
Carex sp.	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.18
Epilobium sp.	12.28	9.87	4.18	18.59	117.61	29.78	35.68	11.71	7.62	28.51	27.58	275.83
Festuca sp.	0.00	8.46	0.00	1.35	1.67	3.97	7.66	0.00	1.60	0.16	2.49	24.87
Fragaria sp.	0.00	0.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.46
Linnaea borealis	0.00	0.00	0.00	14.49	7.97	0.00	23.43	0.00	0.00	0.00	4.59	45.89
Lupinus sp.	0.00	44.28	23.28	0.25	29.11	14.93	6.12	8.64	24.07	6.05	15.68	156.83
Rosa sp.	0.00	0.00	0.00	0.00	0.00	0.00	26.09	0.00	0.00	0.00	2.61	26.09
Total	14.8	63.07	60.69	34.68	156.36	48.68	98.98	23.76	33.29	34.72	56.90	569.03

Table 3. Dry weights (g/m^2) of 10 vegetation samples collected from Block 4.

Species\Plot #	1	2	3	4	5	6	7	8	9	10	Mean	kg/ha
Arctostaphylos sp.	0.00	0.00	0.00	0.00	0.00	68.07	0.00	33.84	0.00	0.00	10.19	101.91
Bromus sp.	0.11	0.00	0.00	0.00	0.00	0.69	0.00	0.00	0.00	0.00	0.08	0.80
Calamagrostis sp.	0.00	0.00	0.00	16.83	0.00	0.00	0.00	0.00	0.00	0.00	1.68	16.83
Epilobium sp.	3.87	10.59	3.58	5.81	0.73	0.00	1.94	0.00	3.38	0.00	2.99	29.90
Festuca sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.05	0.00	0.11	1.05
Linnaea sp.	0.00	5.28	0.00	0.00	0.00	0.00	2.93	0.00	0.00	4.32	1.25	12.53
Lupinus sp.	81.92	49.16	53.81	21.65	2.30	20.46	87.33	2.09	115.98	76.08	51.08	510.78
Pyrola sp.	0.00	1.18	0.00	0.00	0.00	0.48	0.00	0.00	0.00	0.00	0.17	1.66
Solidago sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.02	0.18
Total	85.90	66.21	57.39	44.29	3.03	89.70	92.20	35.93	120.44	80.58	67.56	675.64

Table 4. Dry weights (g/m^2) of 10 vegetation samples collected from Block 5.

Species\Plot #	1	2	3	4	5	6	7	8	9	10	Mean	kg/ha
Arctostaphylos sp.	0.00	0.00	0.00	0.00	0.00	41.48	0.00	0.00	0.00	0.00	4.15	41.48
Bromus sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	19.18	1.92	19.18
Epilobium sp.	20.01	5.57	13.41	0.21	1.68	1.72	28.47	1.08	11.75	12.55	9.65	96.45
Festuca sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.41	0.00	1.24	12.41
Lupinus sp.	5.85	43.64	4.70	116.46	54.59	24.45	1.85	55.07	1.58	49.14	35.73	357.33
Solidago sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.71	0.00	0.00	0.00	0.07	0.71
Total	25.86	49.21	18.11	116.67	56.27	67.65	31.03	56.15	25.74	80.87	52.76	527.56

Table 5. Dry weights (g/m^2) of 10 vegetation samples collected from Block 6.

Species\Plot #	1	2	3	4	5	6	7	8	9	10	Mean	kg/ha
Arctostaphylos sp.	58.29	7.22	0.00	0.00	4.95	25.04	33.72	13.35	14.02	0.00	15.66	156.59
Bromus sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.80	2.38	4.23	1.04	10.41
Calamagrostis sp.	0.00	0.00	12.89	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.29	12.89
Carex sp.	0.06	0.00	0.00	0.00	0.00	0.97	0.17	0.00	0.00	0.00	0.12	1.20
Epilobium sp.	15.17	6.11	48.25	40.55	5.16	5.44	0.00	11.58	4.39	8.73	14.54	145.38
Festuca sp.	6.23	0.00	0.00	0.39	0.00	0.00	0.00	0.00	0.00	0.00	0.66	6.62
Lupinus sp.	4.32	3.44	3.79	0.51	0.00	32.25	30.64	59.56	47.40	18.32	20.02	200.23
Pyrola sp.	0.00	0.00	0.00	1.93	0.00	0.00	0.00	0.00	0.00	0.00	0.19	1.93
Solidago sp.	0.00	0.00	3.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.30	3.04
Total	84.07	16.77	67.97	43.38	10.11	63.70	64.53	88.29	68.19	31.28	53.82	538.29

Table 6. Dry weights (g/m^2) of 10 vegetation samples collected from Block 7.

Species\Plot #	1	2	3	4	5	6	7	8	9	10	Mean	kg/ha
Achillea sp.	0.00	0.39	0.00	0.00	0.00	0.33	0.00	0.00	0.00	0.43	0.12	1.15
Arctostaphylos sp.	0.00	0.00	0.00	51.81	47.35	0.00	0.00	0.00	0.00	0.00	9.92	99.16
Bromus sp.	0.00	50.47	0.00	0.00	0.00	18.71	0.00	0.00	0.00	0.00	6.93	69.18
Calamagrostis sp.	0.00	0.00	34.39	0.00	0.00	0.00	0.00	0.00	11.51	0.00	4.59	45.90
Carex sp.	0.00	0.00	2.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.22	2.19
Epilobium sp.	5.83	45.03	30.98	6.54	15.14	49.91	15.96	36.84	11.62	18.03	23.59	235.88
Festuca sp.	4.93	0.00	0.00	0.00	34.18	0.00	0.00	8.53	0.00	0.00	4.76	47.64
Lupinus sp.	2.80	0.00	11.96	29.32	2.44	47.34	99.09	24.15	4.43	43.36	26.49	264.86
Pyrola sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.55	1.89	0.00	0.84	8.44
Shepherdia sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.48	0.00	0.00	0.00	0.05	0.48
Solidago sp.	0.00	0.00	8.53	0.00	0.82	21.82	0.00	0.00	0.00	2.82	3.40	33.99
Total	13.56	95.89	88.05	87.67	99.93	138.11	115.5	76.07	29.45	64.64	80.89	808.87

Table 7. Dry weights (g/m^2) of 10 vegetation samples collected from Block 9.

Species\Plot #	1	2	3	4	5	6	7	8	9	10	Mean	kg/ha
Achillea sp.	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.58	0.00	0.00	0.07	0.65
Astragalus sp.	0.00	0.00	0.00	0.00	0.00	0.00	16.95	0.00	0.06	0.00	1.70	17.01
Calamagrostis sp.	8.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.70	1.78	17.82
Carex sp.	0.00	0.00	10.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.03	10.29
Epilobium sp.	3.17	23.22	0.51	24.12	7.25	19.77	7.83	9.55	3.28	17.39	11.61	116.09
Festuca sp.	0.00	9.49	0.00	2.63	9.76	6.37	0.00	0.00	0.16	0.00	2.84	28.41
Fragaria sp.	0.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.26
Lupinus sp.	30.28	0.00	0.73	0.00	0.00	18.33	2.76	2.10	10.30	2.10	6.66	66.60
Solidago sp.	0.52	0.55	0.00	0.00	0.00	0.63	0.00	0.49	0.23	0.00	0.24	2.42
Total	42.35	33.26	11.53	26.75	17.01	45.17	27.54	12.72	14.03	29.19	25.96	259.55

Table 8. Dry weights (g/m^2) of 10 vegetation samples collected from Block 10.

Species\Plot #	1	2	3	4	5	6	7	8	9	Mean	kg/ha
Achillea sp.	0.00	0.00	0.00	0.10	0.00	0.17	0.00	0.00	0.00	0.03	0.30
Arctostaphylos sp.	0.00	0.00	0.00	56.06	0.00	0.00	0.00	0.00	0.00	6.23	62.29
Astragalus sp.	0.23	14.71	13.79	0.00	0.00	0.00	3.52	9.59	0.00	4.65	46.49
Calamagrostis sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.02	0.17
Epilobium sp.	1.03	18.89	2.21	5.35	10.29	6.55	16.15	9.35	0.28	7.79	77.89
Festuca sp.	0.65	0.46	0.35	4.03	3.11	6.97	38.83	1.13	0.00	6.17	61.70
Lupinus sp.	0.00	0.00	0.00	0.00	0.00	25.62	0.00	0.00	0.00	2.85	28.47
Shepherdia sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.39	0.00	0.15	1.54
Solidago sp.	0.00	0.00	0.00	1.12	0.00	0.00	0.00	0.00	0.00	0.12	1.24
Total	1.91	34.06	16.35	66.66	13.40	39.31	58.50	21.46	0.43	28.01	280.09

Table 9. Dry weights (g/m^2) of 10 vegetation samples collected from Block 11.

Species\Plot #	1	2	3	4	5	6	7	8	9	10	Mean	kg/ha
Achillea sp.	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.20
Astragalus sp.	0.00	0.00	0.00	0.00	9.61	0.00	17.51	0.00	0.00	0.00	2.71	27.12
Bromus sp.	1.03	0.00	0.00	0.00	0.00	35.99	1.63	22.19	0.00	4.97	6.58	65.81
Epilobium sp.	11.53	18.39	19.65	1.28	2.76	17.36	8.75	11.35	7.38	7.19	10.56	105.64
Festuca sp.	0.00	0.07	4.42	5.75	0.00	0.00	27.96	0.00	23.35	0.00	6.16	61.55
Fragaria sp.	0.00	0.00	6.97	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.70	6.97
Gramineae	0.00	0.00	1.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	1.29
Lupinus sp.	11.29	0.44	6.14	3.33	16.31	0.00	0.00	0.00	0.00	0.00	3.75	37.51
Pyrola sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.81	0.00	0.00	0.00	0.08	0.81
Shepherdia sp.	0.00	30.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.04	30.44
Solidago sp.	1.89	0.00	3.69	0.00	0.00	0.00	0.00	0.58	2.25	0.00	0.84	8.41
Total	25.94	49.34	42.16	10.36	28.68	53.35	56.66	34.12	32.98	12.16	34.57	345.75

Table 10. Dry weights (g/m^2) of 10 vegetation samples collected from Block 12.

Species\Plot #	1	2	3	4	5	6	7	8	9	Mean	kg/ha
Achillea sp.	0.00	0.00	0.00	0.00	0.00	0.53	0.00	0.00	0.00	0.06	0.59
Arctostaphylos sp.	0.00	0.00	0.00	0.00	0.00	0.00	2.46	0.00	0.00	0.27	2.73
Artemisia sp.	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.004	0.04
Astragalus sp.	20.27	20.57	0.00	0.62	0.00	0.00	0.00	0.00	4.18	5.07	50.71
Bromus sp.	0.00	30.05	0.00	0.00	1.17	0.00	31.28	0.00	0.00	6.94	69.44
Calamagrostis sp.	0.00	0.00	56.97	0.00	0.00	0.00	0.00	0.00	0.00	6.33	63.30
Epilobium sp.	5.39	19.98	10.53	73.82	12.87	23.71	22.94	14.42	0.00	20.41	204.07
Festuca sp.	13.20	0.00	0.00	45.58	3.65	0.32	0.00	2.43	0.14	7.26	72.58
Lupinus sp.	0.00	0.00	11.52	0.36	5.94	28.51	2.56	0.00	0.00	5.43	54.32
Rosa sp.	64.36	3.88	20.44	0.00	0.00	0.00	0.00	0.00	21.62	12.26	122.56
Total	103.22	74.48	99.46	120.38	23.67	53.07	59.24	16.85	25.94	64.03	640.33

Table 11. Dry weights (g/m^2) of 10 vegetation samples collected from Block 13.

Species\Plot #	1	2	3	4	5	6	7	8	9	10	Mean	kg/ha
Arctostaphylos sp.	0.00	14.77	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.48	14.77
Aster sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	31.40	0.00	0.00	3.14	31.40
Astragalus sp.	3.92	0.00	0.00	0.00	0.00	0.00	38.19	0.00	0.00	0.00	4.21	42.11
Bromus sp.	0.00	0.00	0.00	0.00	21.80	0.00	0.00	0.00	0.00	0.00	2.18	21.80
Calamagrostis sp.	22.32	27.38	0.00	0.00	0.00	0.00	7.82	0.00	0.00	0.00	5.75	57.52
Epilobium sp.	51.94	13.27	2.80	25.60	9.25	41.72	12.54	0.00	0.32	56.30	21.37	213.74
Festuca sp.	0.00	0.00	0.00	23.26	0.00	3.16	0.00	31.95	0.02	78.38	13.68	136.77
Fragaria sp.	0.00	0.00	0.00	0.00	0.00	8.18	0.00	0.00	0.00	0.00	0.82	8.18
Gramineae	0.00	0.00	0.00	0.00	0.00	0.23	18.47	0.00	0.00	0.00	1.87	18.70
Lupinus sp.	0.00	0.93	22.22	2.20	0.30	25.12	0.00	0.00	41.97	3.98	9.67	96.72
Rosa sp.	0.00	0.00	0.00	0.00	0.00	0.00	19.98	0.00	0.00	0.00	2.00	19.98
Solidago sp.	0.00	0.00	0.00	0.00	0.00	0.87	0.00	3.36	0.00	0.00	0.42	4.23
Total	78.18	56.35	25.02	51.06	31.35	79.28	97.00	66.71	42.31	138.66	66.59	665.92

Table 12. Dry weights (g/m^2) of 10 vegetation samples collected from Block 14.

Species\Plot #	1	2	3	4	5	6	7	8	9	10	Mean	kg/ha
Arctostaphylos sp.	0.00	0.00	0.00	4.01	0.00	0.00	0.00	0.00	0.00	0.00	0.40	4.01
Astragalus sp.	28.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.62	2.99	29.91
Bromus sp.	0.00	33.58	77.89	0.00	0.00	0.00	0.00	44.75	0.00	0.00	15.62	156.22
Calamagrostis sp.	0.00	0.00	0.00	0.00	51.94	0.00	42.35	0.00	15.08	0.00	10.94	109.37
Epilobium sp.	2.96	15.31	34.59	7.34	12.07	0.00	13.26	18.97	6.73	22.95	13.42	134.18
Festuca sp.	3.16	0.00	0.00	0.61	0.00	8.58	0.00	0.00	0.00	49.73	6.21	62.08
Fragaria sp.	0.00	1.82	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18	1.82
Linnaea sp.	0.00	0.00	4.88	0.00	0.00	5.75	0.00	0.00	0.00	0.00	1.06	10.63
Lupinus sp.	0.00	0.00	44.10	12.82	0.00	64.96	0.00	0.37	0.00	0.00	12.22	122.25
Rosa sp.	0.00	0.00	0.00	0.00	0.00	0.00	2.14	0.00	0.00	9.09	1.12	11.23
Solidago sp.	0.00	0.00	0.00	0.00	0.00	0.00	5.36	0.00	0.00	0.00	0.54	5.36
Total	34.41	50.71	161.46	24.78	64.01	79.29	63.11	64.09	21.81	83.39	64.70	647.06

Table 13. Dry weights (g/m^2) of 10 vegetation samples collected from Block 15.

Species\Plot #	1	2	3	4	5	6	7	8	9	10	Mean	kg/ha
Astragalus sp.	0.00	34.93	3.88	0.00	0.00	0.36	0.00	27.78	1.21	0.00	6.82	68.16
Bromus sp.	0.00	4.97	0.00	0.00	0.00	0.00	0.00	0.00	5.91	0.00	1.09	10.88
Calamagrostis sp.	5.98	0.00	13.95	3.19	0.00	19.11	0.00	0.00	22.59	2.57	6.74	67.39
Epilobium sp.	21.79	3.42	2.65	20.66	3.54	5.44	9.39	2.25	29.04	8.79	10.70	106.97
Festuca sp.	0.00	0.00	0.00	0.00	7.48	0.00	0.00	0.00	0.00	0.00	0.75	7.48
Solidago sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.03	0.00	0.40	4.03
Total	27.77	43.32	20.48	23.85	11.02	24.91	9.39	30.03	62.78	11.36	26.49	264.91

Table 14. Dry weights (g/m^2) of 10 vegetation samples collected from Block 16.

Species\Plot #	1	2	3	4	5	6	7	8	9	10	Mean	kg/ha
Artemisia sp.	0.00	0.00	0.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.46
Aster sp.	0.00	0.00	0.00	0.00	0.26	0.00	0.00	0.00	0.00	0.00	0.03	0.26
Astragalus sp.	0.00	5.68	0.00	55.46	0.00	13.10	21.16	15.94	18.02	23.93	15.33	153.29
Calamagrostis sp.	43.59	0.00	0.00	0.00	6.80	42.36	0.13	0.00	0.00	0.00	9.29	92.88
Epilobium sp.	4.65	7.71	19.15	29.72	0.00	22.76	5.18	3.77	3.41	18.48	11.48	114.83
Festuca sp.	0.00	5.50	5.65	1.73	0.00	0.00	0.00	0.00	0.00	0.79	1.37	13.67
Rosa sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.65	0.00	9.17	1.38	13.82
Shepherdia sp.	0.00	11.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.18	11.80
Solidago sp.	1.73	0.00	0.00	3.83	0.00	0.00	0.00	0.00	0.00	0.00	0.56	5.56
Total	49.97	30.69	25.26	90.74	7.06	78.22	26.47	24.36	21.43	52.37	40.66	406.57

Table 15. Dry weights (g/m^2) of 10 vegetation samples collected from Block 17.

Species\Plot #	1	2	3	4	5	6	7	8	9	10	Mean	kg/ha
Aster sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.21	0.00	1.33	0.25	2.54
Astragalus sp.	10.83	0.00	10.58	18.28	7.44	0.00	0.00	0.00	2.21	0.00	4.93	49.34
Bromus sp.	0.00	0.00	28.30	18.40	0.00	24.22	0.00	0.00	0.00	0.00	7.09	70.92
Calamagrostis sp.	0.00	0.00	0.00	0.00	15.38	0.00	0.00	16.08	0.00	0.00	3.15	31.46
Epilobium sp.	1.06	9.42	18.14	10.11	0.00	7.19	0.00	0.00	0.00	0.00	4.59	45.92
Festuca sp.	0.00	0.29	0.00	0.00	0.00	0.00	6.63	0.00	0.48	0.00	0.74	7.40
Rosa sp.	0.00	0.00	41.96	2.86	16.53	0.00	5.93	2.43	0.00	0.00	6.97	69.71
Salix sp.	0.00	0.00	0.00	0.00	37.94	0.00	0.00	0.00	7.10	0.00	4.50	45.04
Shepherdia sp.	0.00	0.00	0.00	0.00	0.00	8.97	0.00	0.00	0.00	0.00	0.90	8.97
Unknown	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.41	0.00	0.64	6.41
Total	11.89	9.71	98.98	49.65	77.29	40.38	12.56	19.72	16.20	1.33	33.77	337.71

Table 16. Dry weights (g/m^2) of 10 vegetation samples collected from Block 18.

Species\Plot #	1	2	3	4	5	Mean	kg/ha
Arctostaphylos sp.	0.00	0.00	0.00	3.59	0.00	0.72	7.18
Astragalus sp.	52.37	1.15	0.00	0.00	8.61	12.43	124.26
Bromus sp.	0.00	0.00	0.00	0.00	6.86	1.37	13.72
Calamagrostis sp.	0.00	0.00	0.00	10.35	0.00	2.07	20.70
Epilobium sp.	0.00	14.19	29.23	58.85	1.74	20.80	208.02
Festuca sp.	4.06	0.00	0.14	0.00	0.00	0.84	8.40
Fragaria sp.	23.14	0.00	0.00	4.38	0.00	5.50	55.04
Salix sp.	39.84	0.00	0.00	0.00	0.00	7.97	79.68
Solidago sp.	0.00	0.00	2.35	0.00	0.00	0.47	4.70
Total	119.41	15.34	31.72	77.17	17.21	52.17	521.70