

Technical Report No. 84

THE BRIDGER SITE

1970 PROGRESS REPORT

Don Collins

Botany Department

Montana State University

Bozeman, Montana 59715

GRASSLAND BIOME

U.S. International Biological Program

March 1971

TABLE OF CONTENTS

	Page
Title Page	i
Table of Contents	ii
Abstract	iii
Introduction	1
Methods	1
Results	3
Appendix I	31

ABSTRACT

Field data from investigations of aboveground primary production during the 1970 growing season at the Bridger Site are summarized and tabulated. Included are results from grazed and ungrazed areas, as well as two locations on which snow accumulation was artificially increased. Results from a sample of belowground biomass of plant material are also presented, as well as summary charts of air and soil temperatures through the growing season.

INTRODUCTION

The Bridger Site, located at 7800 feet MSL in the Bridger Mountains near Bozeman, Montana, is the highest and northernmost of the sites comprising the Comprehensive Network of the Grasslands Program of the US IBP. The site is described in IBP Technical Report No. 38. The site was selected in 1969 for inclusion in the Comprehensive Network. This report will describe the work conducted during that period and present a synthesis of the research data gathered during the 1970 growing season.

METHODS

Two basic treatments were used during the 1970 growing season, as prescribed by IBP Technical Report No. 35. These were: (i) an area which had long been excluded from grazing use, referred to as a "non-grazed area;" and (ii) an area which had received "light" grazing during the preceding (1969) growing season, referred to as a "grazed area." The site selected as the "non-grazed site" was one which had been under fence and excluded from grazing use since the 1930's. Total acreage involved was approximately 35 acres. An area directly adjoining the ungrazed site, supporting a very similar vegetational community, was selected as the grazed area. This area was fenced with 4 inch mesh fencing in early June, prior to grazing use. Two areas which appeared to be similar in their vegetational composition were selected within each treatment as replicates. Within each replicate, 15 ten m permanent transects were installed. Ten transects in each replicate were selected on a random basis for studies designed to determine vegetational productivity. The remaining five transects in each replicate were used for phenological

studies and soil-moisture determinations. In each of these five transects, "stacks" of soil moisture blocks were buried at 10 cm, 25 cm and 75 cm depths. Readings were made on a weekly basis during the growing season. Phenological measurements, including stage of development, leaf length, and culm length (where applicable), were gathered on the 21 species considered "most important" from a productivity standpoint.

Aboveground vegetational productivity measurements were initially taken June 23 on both the grazed and ungrazed areas and continued until September 1 on a biweekly basis. Ten 0.5 m^2 quadrats were clipped at crown level in each replicate at each sampling period. A "clip-rank" method of sampling was used. This involves: (i) ranking all species which contribute over 5% of the total productivity according to their relative individual productivities; (ii) clipping these species individually; and (iii) separating the remaining biomass into miscellaneous grasses, miscellaneous forbs, standing dead, and litter. Plant material was then dried for 24 hours at 65°C and weighed to the nearest gram. The results were then recorded on the appropriate forms. In addition, seventy additional 0.5 m^2 plots in each replicate were "ranked only" in the prescribed manner. All data were then submitted to the central laboratory at Colorado State University for mathematical analysis. In all cases, data were submitted within ten days after sampling. The data resulting from the vegetational sampling is summarized in this report.

Belowground biomass was estimated September 10 using soil cores. Ten cores, each 2 cm in diameter, were taken in each replicate to depths of 50 cm or bedrock. Each core was then separated into 10 cm intervals, with the exception of the upper 10 cm, which was subdivided into 5 cm increments.

The cores were then washed over a 32 mesh screen, oven dried at 65°C, weighed to the nearest 0.01 gram, washed, and the residue weighed. This data is also presented in this report.

In addition, standard weather bureau instruments were used to gather continuous data on air temperature, relative humidity, and soil temperatures at 10 cm and 50 cm. Weekly readings were taken on precipitation, wind and air maximum and minimum temperatures. All measurements were taken during the snow-free season only, which in 1970 involved the period from June 4 to September 11. A brief summary of some of these measurements is included in this report.

RESULTS

Aboveground productivity measurements were taken six times during the 1970 growing season. The sampling dates were June 22, July 8 and 20, August 3 and 17, and September 1. The resulting data is synthesized and presented on the following pages.

In addition to the grazing stress program conducted for the IBP, a study was also carried out at this site to determine the effects of increased snow-pack on the vegetational community. The snow depths involved were 4 ft and 9 ft, compared to the normal snow depth of 1½ to 2 ft.

This project, presently in its third year, is funded by the National Science Foundation under the direction of the author. Many of the graphs in this report include data from this project as well as data from the IBP study.

Table 1. Vegetational productivity. 1970 control plot replicate 1,
g/m² (dry weight).

Species	Date of Sample					
	June 22	July 8	July 20	Aug. 3	Aug. 17	Aug. 31
<i>Festuca idahoensis</i>						
mean	14.20	26.18	34.58	37.61	31.97	29.18
standard deviation	5.26	14.27	15.84	13.59	12.42	7.48
<i>Agropyron subsecundum</i>						
mean	8.96	22.22	20.90	31.66	19.87	29.93
standard deviation	3.86	12.68	7.97	20.10	19.57	26.85
<i>Danthonia intermedia</i>						
mean	.71	3.35	3.49	6.75	4.41	3.77
standard deviation	.96	6.00	3.00	9.10	3.03	2.26
<i>Koeleria cristata</i>						
mean	.72	1.39	2.04			
standard deviation	.96	1.97	3.44			
Miscellaneous grasses						
mean	4.04	3.56	17.47	24.83	7.60	8.81
standard deviation	3.12	3.99	17.34	9.20	7.42	4.68
<i>Lupinus argenteus</i>						
mean	2.53	11.86	20.24	20.57	19.39	23.09
standard deviation	2.57	8.51	16.38	20.94	14.92	22.08
<i>Arenaria congesta</i>						
mean	1.41	2.28	3.29	5.31	2.13	2.16
standard deviation	1.36	1.98	4.78	5.97	2.83	1.83
<i>Achillea millefolia</i>						
mean	.68	1.47	2.13	2.86	1.49	2.47
standard deviation	.70	1.51	.81	3.52	1.06	2.19
<i>Agoseris</i> species						
mean	.56	.68	1.78	4.30	1.35	1.95
standard deviation	.90	1.25	2.13	9.75	2.29	2.45
<i>Erigeron speciosus</i>						
mean	.70	2.78		5.55		
standard deviation	.72	6.21		6.05		

Table 1. (Continued)

Species	Date of Sample					
	June 22	July 8	July 20	Aug. 3	Aug. 17	Aug. 31
<i>Cerastium arvense</i>						
mean		2.74	3.06			
standard deviation		3.75	3.00			
<i>Galium boreale</i>						
mean				6.29	3.06	
standard deviation				13.19	4.20	
Miscellaneous forbs						
mean	12.87	20.66	20.07	21.72	14.78	20.46
standard deviation	2.51	11.81	7.42	14.19	8.76	12.76
Standing dead						
mean	36.50	8.73	2.95	1.81	.64	14.13
standard deviation	12.74	10.28	4.75	3.97	1.15	6.83
Total live and dead						
mean	83.91	107.88	131.93	169.24	111.74	137.06
standard deviation	18.47	36.63	27.80	32.13	18.22	47.11

Table 2. Vegetational productivity. 1970 control plot replicate 2,
g/m² (dry weight).

Species	Date of Sample					
	June 22	July 8	July 20	Aug. 3	Aug. 17	Aug. 31
<i>Pestuca idahoensis</i>						
mean	24.98	29.84	33.42	33.67	56.21	33.20
standard deviation	13.75	14.43	13.09	24.45	22.33	16.38
<i>Agropyron subsecundum</i>						
mean	10.38	24.46	24.12	18.01	25.54	10.47
standard deviation	5.03	16.30	34.24	19.96	30.97	7.69
<i>Danthonia intermedia</i>						
mean	2.18	2.40	7.00	8.46	2.38	.92
standard deviation	2.67	2.89	5.08	5.86	2.74	1.25
<i>Koeleria cristata</i>						
mean	.69	1.53	4.12	1.65		
standard deviation	.94	2.06	4.31	2.00		
Miscellaneous grasses						
mean	4.06	7.46	13.35	11.53	9.55	4.68
standard deviation	2.87	5.06	8.82	12.45	7.61	4.86
<i>Lupinus argenteus</i>						
mean	6.05	16.39	17.47	27.26	7.38	4.23
standard deviation	5.31	11.63	17.37	31.71	6.04	8.43
<i>Arenaria congesta</i>						
mean	4.07	2.58	6.80	3.40	2.64	1.57
standard deviation	3.46	4.46	5.81	3.45	1.32	1.13
<i>Achillea millefolia</i>						
mean	1.26	3.51	3.24	1.89	1.52	.78
standard deviation	.79	4.56	2.53	1.51	.94	.59
<i>Agoseris</i> species						
mean	.52	.18	1.47	1.81	1.78	.48
standard deviation	1.09	.40	4.41	3.57	3.21	1.29
<i>Erigeron speciosus</i>						
mean	.40	1.01	5.84	4.20		
standard deviation	.69	2.53	7.62	4.93		

Table 2. (Continued)

Species	Date of Sample					
	June 22	July 8	July 20	Aug. 3	Aug. 17	Aug. 31
<i>Cerastium arvense</i>						
mean		1.01	5.04	3.84		
standard deviation		1.26	3.75	5.30		
<i>Galium boreale</i>						
mean					6.53	
standard deviation					7.88	
Miscellaneous forbs						
mean	24.41	29.95	37.98	24.69	16.97	8.45
standard deviation	8.17	20.25	12.08	14.89	11.67	8.86
Standing dead						
mean	34.59	5.05	8.43	9.96	.74	26.60
standard deviation	18.12	4.39	9.49	11.01	.99	17.46
Total live and dead						
mean	113.57	125.35	168.27	150.34	132.86	92.91
standard deviation	25.90	56.74	49.68	48.16	39.59	36.42

Table 3. Vegetational productivity. 1970 control plots (both replicates), g/m² (dry weight).

Species	Date of Sample					
	June 22	July 8	July 20	Aug. 3	Aug. 17	Aug. 31
<i>Festuca idahoensis</i>						
mean	19.60	28.01	34.00	35.64	44.09	31.28
standard deviation	10.44	14.35	14.53	19.78	18.07	12.93
<i>Agropyron subsecundum</i>						
mean	9.67	23.34	22.50	24.84	22.70	19.74
standard deviation	4.49	14.60	24.86	17.93	25.90	19.35
<i>Danthonia intermedia</i>						
mean	1.45	2.88	5.24	7.61	3.39	2.27
standard deviation	2.00	4.71	4.18	7.65	2.89	1.80
<i>Koeleria cristata</i>						
mean	.70	1.46	3.03	.83		
standard deviation	.95	2.01	3.90	1.41		
Miscellaneous grasses						
mean	4.05	5.51	15.41	18.19	8.58	6.65
standard deviation	2.99	4.56	13.76	10.95	7.52	4.77
<i>Lupinus argenteus</i>						
mean	4.29	14.13	18.86	23.91	13.39	13.21
standard deviation	4.17	10.20	16.88	26.87	11.39	16.21
<i>Arenaria congesta</i>						
mean	2.74	2.43	5.05	4.35	2.38	1.85
standard deviation	2.63	3.45	5.32	4.38	2.21	1.50
<i>Achillea millefolia</i>						
mean	.97	2.49	2.69	2.37	1.50	1.59
standard deviation	.75	3.40	1.88	2.76	1.00	1.57
<i>Agoseris species</i>						
mean	.54	.47	1.60	3.10	1.56	1.18
standard deviation	1.00	.83	3.40	3.00	2.79	1.93
<i>Erigeron speciosus</i>						
mean	.58	1.90	2.92	4.88		
standard deviation	.73	4.74	5.39	5.52		

Table 3. (Continued)

Species	Date of Sample					
	June 22	July 8	July 20	Aug. 3	Aug. 17	Aug. 31
<i>Gerastium arvense</i>						
mean		1.88	4.50	1.92		
standard deviation		2.80	3.40	3.75		
<i>Galium boreale</i>						
mean				3.15		
standard deviation				9.33		
Miscellaneous forbs						
mean	18.64	25.30	29.03	23.21	15.88	14.17
standard deviation	6.04	16.58	10.02	14.54	10.32	10.89
Standing dead						
mean	35.55	6.89	5.69	5.89	.69	20.66
standard deviation	15.66	7.93	7.51	8.25	1.07	13.49
Total live and dead						
mean	98.77	116.65	150.14	159.84	122.30	113.93
standard deviation	22.50	47.77	40.26	40.95	30.82	41.85

Table 4. Vegetational productivity. 1970 grazed plot, replicate 1, g/m² (dry weight).

Species	Date of Sample					
	June 22	July 8	July 20	Aug. 3	Aug. 17	Sept. 1
<i>Festuca idahoensis</i>						
mean	26.45	21.62	24.81	37.57	28.75	30.01
standard deviation	14.87	11.10	8.27	13.24	7.40	12.66
<i>Agropyron subsecundum</i>						
mean	5.36	14.12	5.28	15.20	10.88	11.73
standard deviation	3.07	17.29	12.31	34.47	16.72	11.86
<i>Danthonia intermedia</i>						
mean	2.38	6.27	7.89	14.70	8.10	11.17
standard deviation	3.09	10.40	6.17	6.65	5.28	6.29
<i>Koeleria cristata</i>						
mean	1.77	0.67	1.05			
standard deviation	2.33	1.45	1.50			
Miscellaneous grasses						
mean	5.86	12.25	14.38	23.68	12.91	7.01
standard deviation	6.09	6.33	10.16	13.04	11.38	7.84
<i>Lupinus argenteus</i>						
mean	7.61	11.15	15.13	7.98	7.86	
standard deviation	9.16	11.53	13.54	10.25	10.64	
<i>Arenaria congesta</i>						
mean	1.68	2.68	3.48	1.47	1.37	2.55
standard deviation	1.40	2.03	2.53	1.69	1.91	1.60
<i>Achillea millefolia</i>						
mean	1.18	3.27	3.91	3.75		
standard deviation	1.30	1.67	3.16	3.61		
<i>Agoseris</i> species						
mean	0.66					
standard deviation	1.09					
<i>Erigeron speciosus</i>						
mean			1.10			
standard deviation			3.24			

Table 4. (Continued)

Species	Date of Sample					
	June 22	July 8	July 20	Aug. 3	Aug. 17	Sept. 1
<i>Cerastium arvense</i>						
mean		0.82	2.11			
standard deviation		0.95	1.80			
<i>Galium boreale</i>						
mean				6.16	.47	
standard deviation				8.11	1.49	
Miscellaneous forbs						
mean	23.51	25.92	19.97	19.97	6.48	11.10
standard deviation	14.64	10.32	12.30	10.90	3.78	7.28
Standing dead						
mean	11.40	3.63	2.38		.10	23.00
standard deviation	10.37	4.21	4.48		.21	11.95
Total live and dead						
mean	87.8	102.37	101.47	130.53	82.04	108.14
standard deviation	39.34	30.54	30.13	53.34	21.37	22.52

Table 5. Vegetational productivity. 1970 grazed plot replicate 2, g/m² (dry weight).

Species	Date of Sample					
	June 22	July 6	July 20	Aug. 3	Aug. 17	Aug. 31
<i>Festuca idahoensis</i>						
mean	21.73	33.16	44.00	40.29	41.71	22.25
standard deviation	12.83	17.80	18.49	20.40	16.99	9.79
<i>Agropyron subsecundum</i>						
mean	3.44	2.40	10.91	8.59	6.38	1.84
standard deviation	3.35	3.90	18.37	8.92	12.18	2.73
<i>Danthonia intermedia</i>						
mean	2.31	7.17	12.79	12.99	17.76	.92
standard deviation	2.38	4.28	7.62	6.75	8.64	1.81
<i>Koeleria cristata</i>						
mean	.62	.32	3.57	2.17		
standard deviation	.75	.60	1.86	2.03		
Miscellaneous grasses						
mean	8.29	15.39	19.22	19.76	14.78	.52
standard deviation	7.22	11.49	5.60	15.12	5.16	1.45
<i>Lupinus argenteus</i>						
mean	10.21	18.10	23.93	25.85	10.53	
standard deviation	10.45	10.09	21.03	20.78	9.34	
<i>Arenaria congesta</i>						
mean	3.03	5.39	4.77	2.41	2.55	.84
standard deviation	2.65	4.40	4.18	2.28	1.48	.63
<i>Achillea millefolia</i>						
mean	1.36	3.11	5.53	5.26	3.46	.92
standard deviation	1.20	1.59	2.68	4.40	1.84	.64
<i>Agoseris</i> species						
mean	.62	3.14	1.05	2.40	3.00	.45
standard deviation	.72	3.37	1.17	3.48	3.23	1.00
<i>Erigeron speciosus</i>						
mean	.66			.49		
standard deviation	1.55			1.55		

Table 5. (Continued)

Species	Date of Sample					
	June 22	July 6	July 20	Aug. 3	Aug. 17	Aug. 31
<i>Cerastium arvense</i>						
mean		2.60	5.54	4.68		
standard deviation		6.84	4.01	3.87		
<i>Galium boreale</i>						
mean					1.97	
standard deviation					2.75	
Miscellaneous forbs						
mean	23.80	20.63	18.32	16.28	14.40	.71
standard deviation	14.07	7.21	9.24	10.23	16.55	.69
Standing dead						
mean	9.11	2.13	2.41	1.62		22.22
standard deviation	7.79	2.21	6.55	4.55		9.80
Total live and dead						
mean	97.53	113.47	152.02	141.75	116.61	51.69
standard deviation	17.37	39.45	32.90	40.98	18.55	18.92

Table 6. Vegetational productivity. 1970 grazed plots (both replicates),
g/m² (dry weight).

Species	Date of Sample					
	June 22	July 8	July 20	Aug. 3	Aug. 17	Sept. 1
<i>Festuca idahoensis</i>						
mean	24.09	27.39	34.405	38.93	35.23	26.13
standard deviation	13.885	14.83	14.325	17.20	13.10	11.32
<i>Agropyron subsecundum</i>						
mean	4.409	8.225	8.095	11.895	8.63	6.79
standard deviation	3.21	12.53	15.635	25.18	14.62	8.60
<i>Danthonia intermedia</i>						
mean	2.345	6.69	10.35	13.34	12.93	6.05
standard deviation	2.755	7.95	6.93	6.70	7.16	4.63
<i>Koeleria cristata</i>						
mean	1.19	1.495	2.305	1.065		
standard deviation	1.73	1.105	1.645	1.230		
Miscellaneous grasses						
mean	7.07	13.82	16.80	21.72	13.84	3.77
standard deviation	6.675	9.275	8.205	14.115	8.84	5.64
<i>Lupinus argenteus</i>						
mean	8.905	14.625	19.53	16.91	9.19	
standard deviation	9.845	10.83	17.685	16.38	10.01	
<i>Arenaria congesta</i>						
mean	2.35	4.035	4.125	1.935	1.96	1.69
standard deviation	2.305	3.45	3.455	2.005	1.71	1.21
<i>Achillea millefolia</i>						
mean	1.26	3.19	4.715	4.50	2.77	2.21
standard deviation	1.25	1.625	2.925	4.02	1.72	1.98
<i>Agoeris</i> species						
mean	.635	1.57	.525	1.20	1.50	.87
standard deviation	.92	2.385	.83	2.46	2.28	2.97
<i>Erigeron speciosus</i>						
mean	.325		.545	.245		
standard deviation	.815		2.29	1.09		

Table 6. (Continued)

Species	Date of Sample					
	June 22	July 8	July 20	Aug. 3	Aug. 17	Sept. 1
<i>Cerastium arvense</i>						
mean		1.705	3.82	2.335		
standard deviation		4.80	3.205	2.735		
<i>Galium boreale</i>						
mean					1.22	
standard deviation					2.21	
Miscellaneous forbs						
mean	23.65	23.27	19.14	17.995	10.44	5.91
standard deviation	14.35	8.90	10.88	10.565	5.35	5.17
Standing dead						
mean	10.25	2.88	2.37	.81	.05	22.61
standard deviation	9.17	3.36	5.61	3.22	.15	10.93
Total live and dead						
mean	92.71	107.95	126.78	136.18	99.33	79.87
standard deviation	30.41	35.29	31.55	47.58	20.01	20.80

Table 7. Bimonthly vegetational productivity 1970. Four food snow fence plots, Bangtail Site. Grams/m² (dry weight).

Species	Date of Sample					
	June 22	July 8	July 20	Aug. 3	Aug. 17	Sept. 1
<i>Festuca idahoensis</i>						
mean	7.98	12.68	25.76	23.04	26.76	24.97
standard deviation	6.21	7.35	9.22	7.14	8.89	12.29
<i>Agropyron subsecundum</i>						
mean	4.59	5.10	4.52	7.06	14.74	7.89
standard deviation	5.19	6.30	5.27	8.24	19.84	12.94
<i>Danthonia intermedia</i>						
mean	.81	2.62	8.55	9.75	4.61	4.12
standard deviation	1.36	3.10	4.57	8.41	3.20	2.05
<i>Koeleria cristata</i>						
mean	.74	.99	5.38	7.18		
standard deviation	.73	1.37	3.49	3.11		
Miscellaneous grasses						
mean	4.21	3.89	7.20	7.74	16.65	9.54
standard deviation	3.01	3.55	3.11	3.71	8.97	7.33
<i>Lupinus argenteus</i>						
mean	6.48	18.11	21.81	21.42	47.12	11.56
standard deviation	4.42	11.40	26.87	14.11	63.94	12.87
<i>Arenaria congesta</i>						
mean	2.01	3.13	8.43	8.63	3.84	2.60
standard deviation	2.82	2.61	7.67	4.60	1.35	2.94
<i>Achillea millefolium</i>						
mean	4.91	4.09	6.97	7.16	10.60	4.05
standard deviation	3.83	2.23	2.27	4.06	10.51	2.62
<i>Agoseris</i> species						
mean	.35	1.95	5.27	2.24	1.93	.65
standard deviation	.74	2.93	8.06	2.56	3.43	1.07
<i>Erigeron speciosus</i>						
mean	.28	3.06	2.78	5.24		
standard deviation	.87	9.68	5.88	7.26		

Table 7. (Continued)

Species	Date of Sample					
	June 22	July 8	July 20	Aug. 3	Aug. 17	Sept. 1
<i>Cerastium arvense</i>						
mean		1.14	1.63	3.12		
standard deviation		2.72	2.20	1.70		
<i>Galium boreale</i>						
mean					5.23	
standard deviation					9.26	
Miscellaneous forbs						
mean	27.58	26.61	34.57	28.96	25.18	15.74
standard deviation	18.06	18.50	28.17	7.06	18.33	10.91
Standing dead						
mean	3.81	.92				15.62
standard deviation	6.44	1.55				7.00
Total live and dead						
mean	65.12	93.30	132.89	131.55	157.78	97.13
standard deviation	21.33	24.24	51.76	28.10	78.58	43.26

Table 8. Bimonthly vegetational productivity 1970. Nine foot snow fence plots, Bangtail Site. Grams/m² (dry weight).

Species	Date of Sample				
	July 8	July 20	Aug. 3	Aug. 17	Sept. 1
<i>Festuca idahoensis</i>					
mean	9.48	7.72	14.70	15.42	16.70
standard deviation	12.16	6.70	9.27	8.99	9.08
<i>Agropyron subsecundum</i>					
mean	4.58	10.50	13.28	25.00	13.61
standard deviation	3.40	8.24	8.74	14.93	6.74
<i>Danthonia intermedia</i>					
mean	.74	.92	5.90	2.65	.59
standard deviation	1.44	.95	6.76	2.86	.79
<i>Koeleria cristata</i>					
mean	.19	.47	3.40		
standard deviation	.40	1.50	4.80		
Miscellaneous grasses					
mean	2.57	6.49	15.19	3.97	4.12
standard deviation	3.70	15.78	15.09	3.24	5.37
<i>Lupinus argenteus</i>					
mean	15.04	28.50	21.16	23.37	13.25
standard deviation	13.11	14.31	13.94	16.73	16.25
<i>Arenaria congesta</i>					
mean	2.95	3.65	4.84	2.65	1.58
standard deviation	4.41	2.97	3.42	2.86	1.12
<i>Achillea millefolia</i>					
mean	2.56	2.90	8.59	5.27	4.89
standard deviation	1.71	4.31	7.72	4.23	4.59
<i>Agoseris species</i>					
mean	1.16	4.07	6.57	5.31	.75
standard deviation	1.79	9.22	7.45	8.39	1.55
<i>Trigeron speciosus</i>					
mean	1.32		6.94		
standard deviation	4.16		8.52		

Table 8. (Continued)

Species	Date of Sample				
	July 8	July 20	Aug. 3	Aug. 17	Sept. 1
<i>Cerastium arvense</i>					
mean	.06	.08	1.10		
standard deviation	.19	.24	1.29		
<i>Galium boreale</i>					
mean				3.55	
standard deviation				4.11	
Miscellaneous forbs					
mean	14.53	28.64	43.10	8.45	10.01
standard deviation	9.34	19.80	34.67	3.21	5.95
Standing dead					
mean	.79	.07	2.46	.18	11.81
standard deviation	1.66	.20	3.90	.48	6.20
Total live and dead					
mean	55.45	93.56	147.26	96.38	77.31
standard deviation	38.11	29.92	22.12	28.05	26.53

Table 9. Bimonthly comparisons of vegetational productivity, Bangtail Site, 1970. Treatments vs control. Grams/m² (dry weight).

Treatments	Date of Sample					
	June 22	July 8	July 20	Aug. 3	Aug. 17	Aug. 31
Control						
mean	98.77	116.65	150.14	159.84	122.30	113.93
standard deviation	22.50	47.77	40.26	40.95	30.82	41.85
4 Foot Snow Fence						
mean	65.12	93.30	132.89	131.55	157.78	97.13
standard deviation	21.33	24.24	51.76	28.10	78.58	43.26
9 Foot Snow Fence						
mean	Prior to	55.45	93.56	147.26	96.38	77.31
standard deviation	snow melt	38.11	29.92	22.12	28.05	26.53
Grazed						
mean	92.71	107.95	126.78	136.18	99.33	79.87
standard deviation	30.41	35.29	31.55	47.58	20.01	20.80

Table 10. Bimonthly litter data, Bangtail Site, 1970. Grams/m² (dry weight).

Treatments	Date of Sample					
	June 22	July 8	July 20	Aug. 3	Aug. 17	Aug. 31
Control I						
mean	49.61	189.84	29.18	66.54	136.59	50.68
standard deviation	52.68	119.27	28.96	35.45	65.83	31.50
Control II						
mean	119.48	115.06	101.50	68.97	107.84	37.05
standard deviation	96.80	112.30	87.81	39.69	40.75	17.91
Grazed I						
mean	128.17	51.72	40.03	21.80	116.49	29.21
standard deviation	68.32	42.47	18.29	14.37	80.25	14.38
Grazed II						
mean	71.74	54.89	15.53	23.75	41.70	26.33
standard deviation	46.30	52.87	8.53	16.31	22.88	8.77
Control I and II						
mean	82.88	152.45	65.34	67.75	122.22	43.87
standard deviation	76.91	115.84	65.38	37.63	54.74	25.62
Grazed I and II						
mean	99.96	53.30	27.78	22.77	79.10	27.77
standard deviation	58.36	47.95	14.27	15.37	59.01	11.91
4 Foot Snow Fence						
mean	153.33	20.58	11.57	9.67	33.02	14.69
standard deviation	70.70	13.49	9.04	5.25	25.89	6.70
9 Foot Snow Fence						
mean		38.14	113.20	53.04	64.00	28.34
standard deviation		14.36	77.07	38.45	31.12	20.37

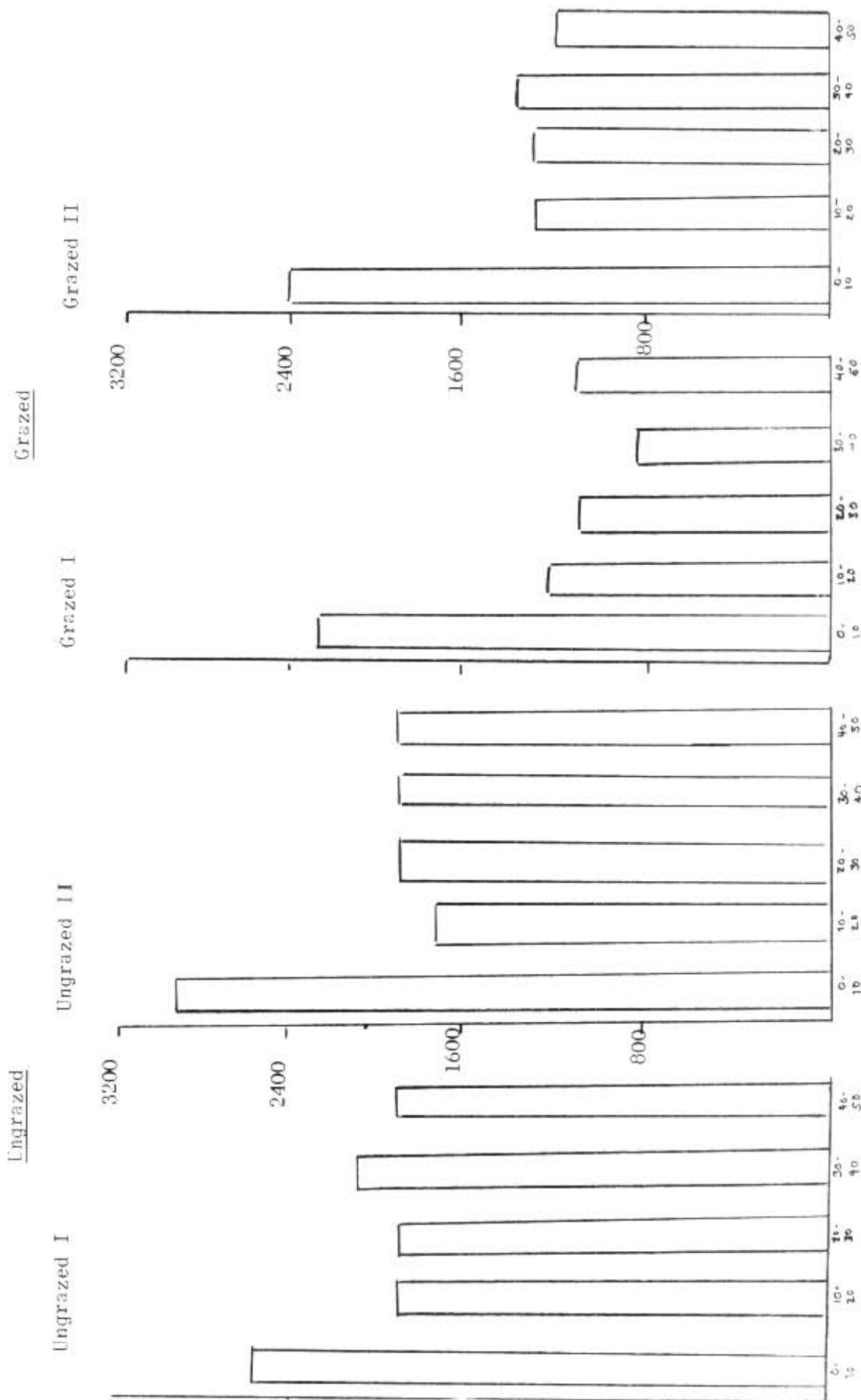


Fig. 1. Belowground biomass, 1970 Bangtail Site. Data expressed in grams per square meter per decimeter. Soil depth expressed in centimeters.

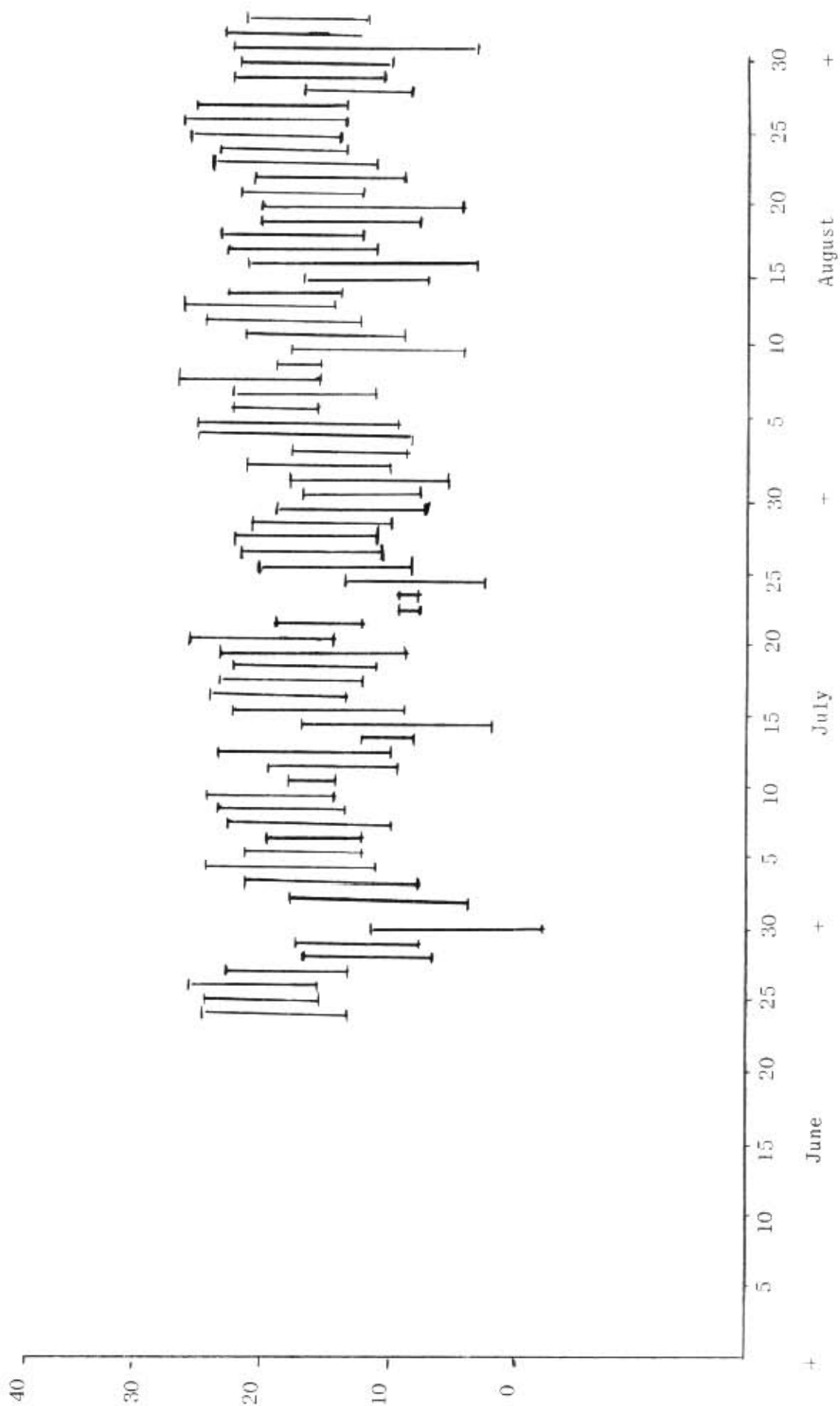


Fig. 2. Air temperatures. Maximum and minimum temperatures at the 1970 Bangtail Site. Data expressed in degrees centigrade.

84

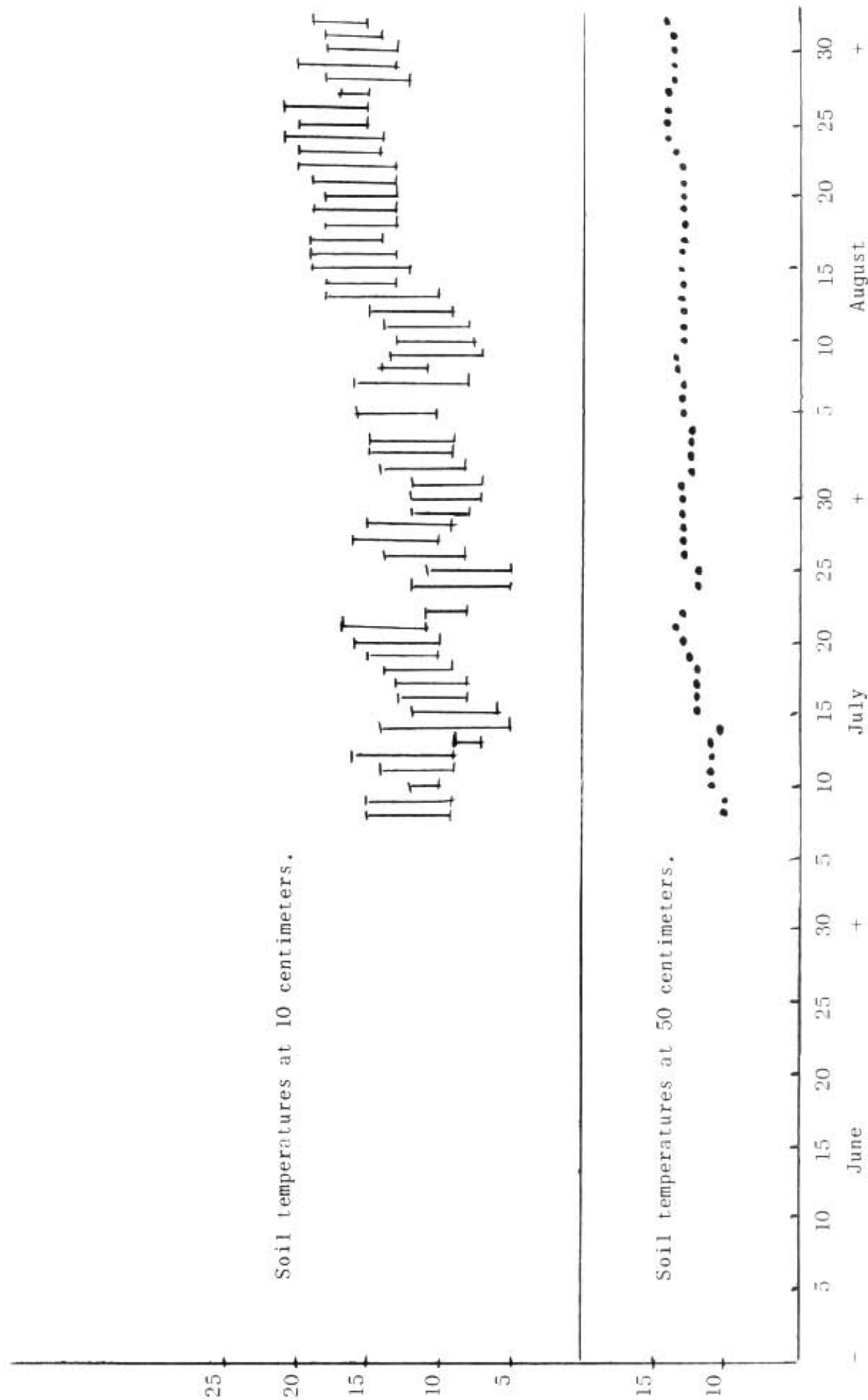


Fig. 3. Soil temperatures at two depths, 1970 Bangtail Site. Daily maximum and minimum shown where available. Data expressed in degrees centigrade.

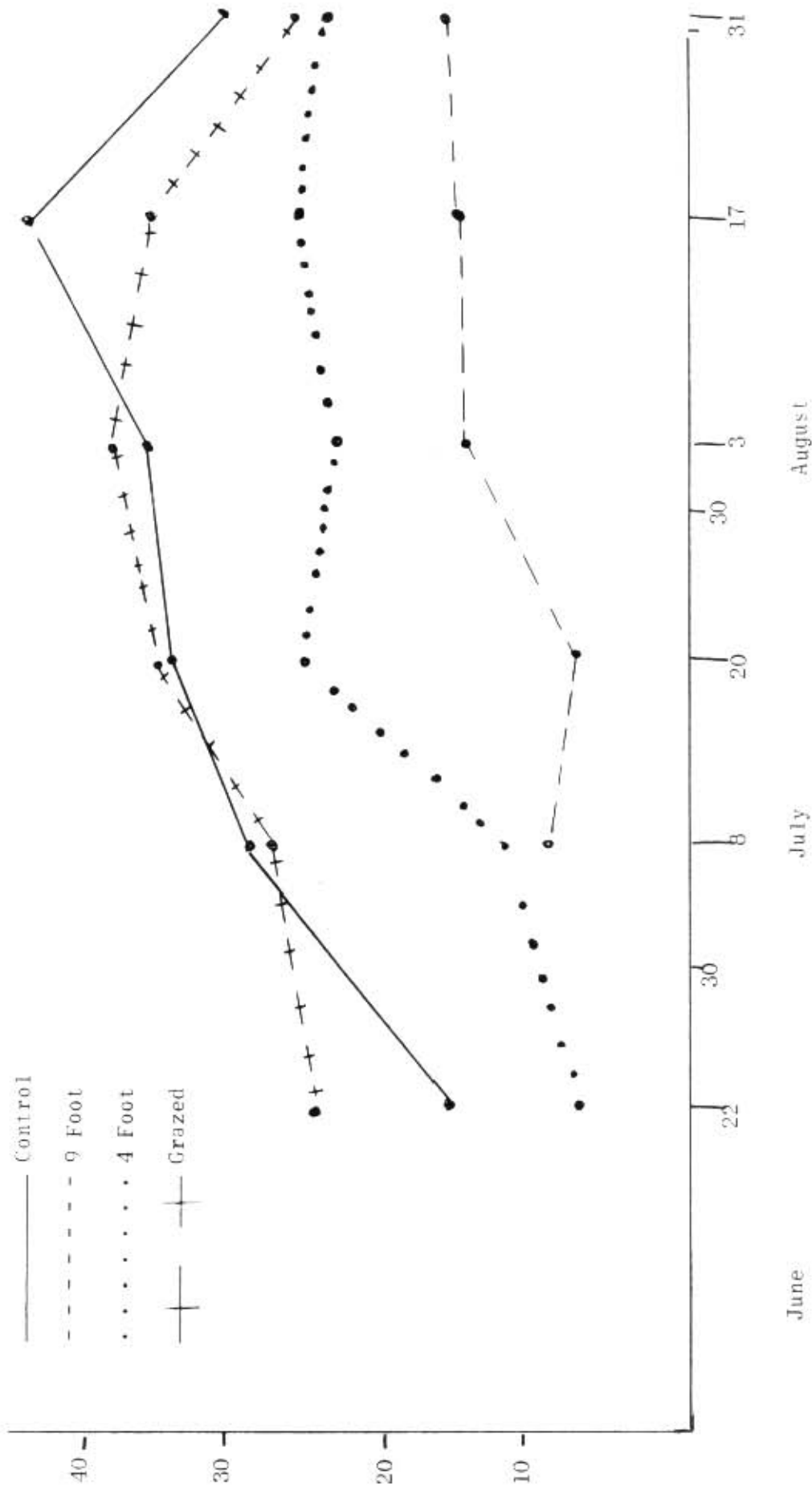


Fig. 4. *Festuca idahoensis*: Standing crop in grams per square meter, 1970 Bangtail Site.

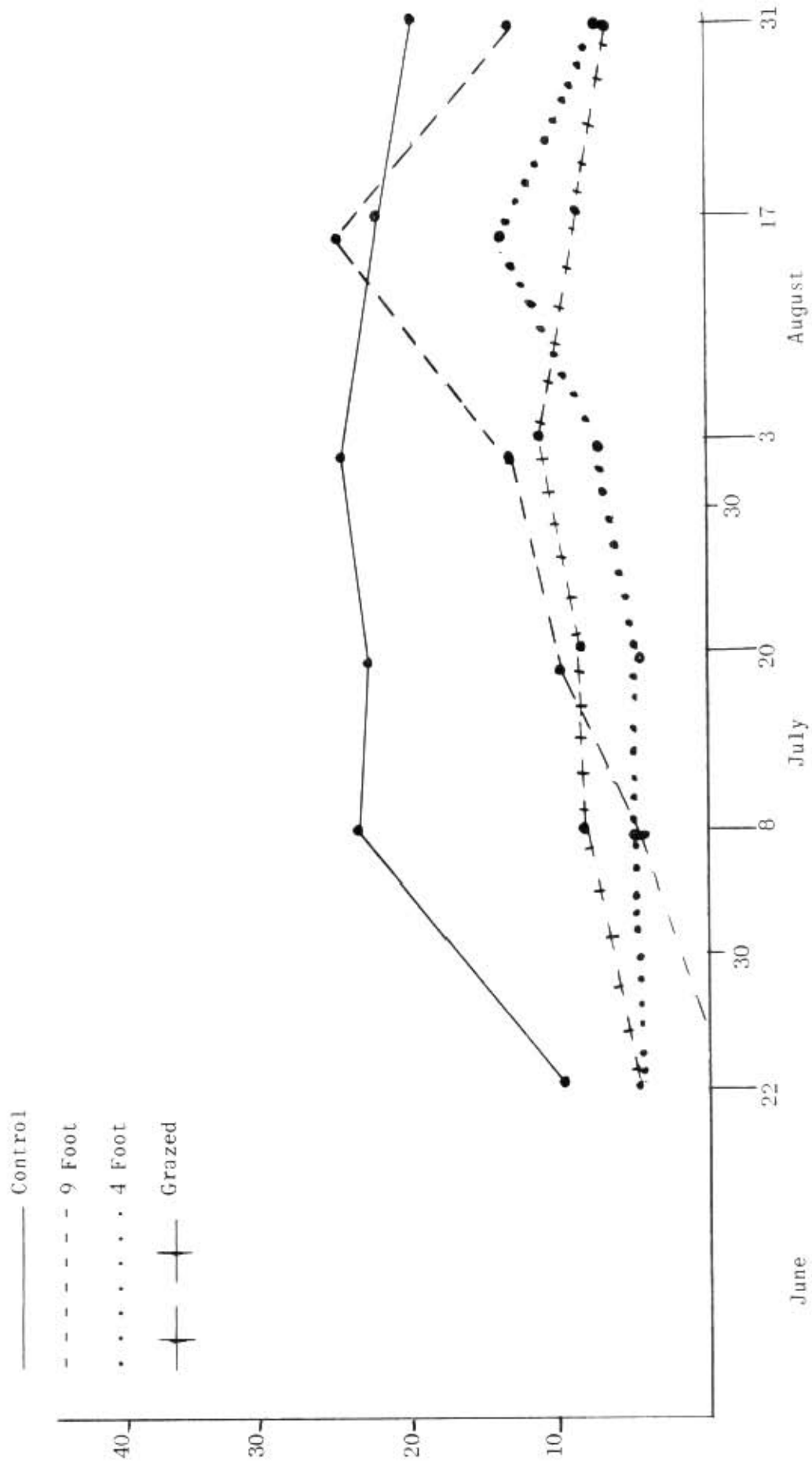


Fig. 5. *Agropyron subsecundum*; Standing crop in grams per square meter, 1970 Bangtail Site.

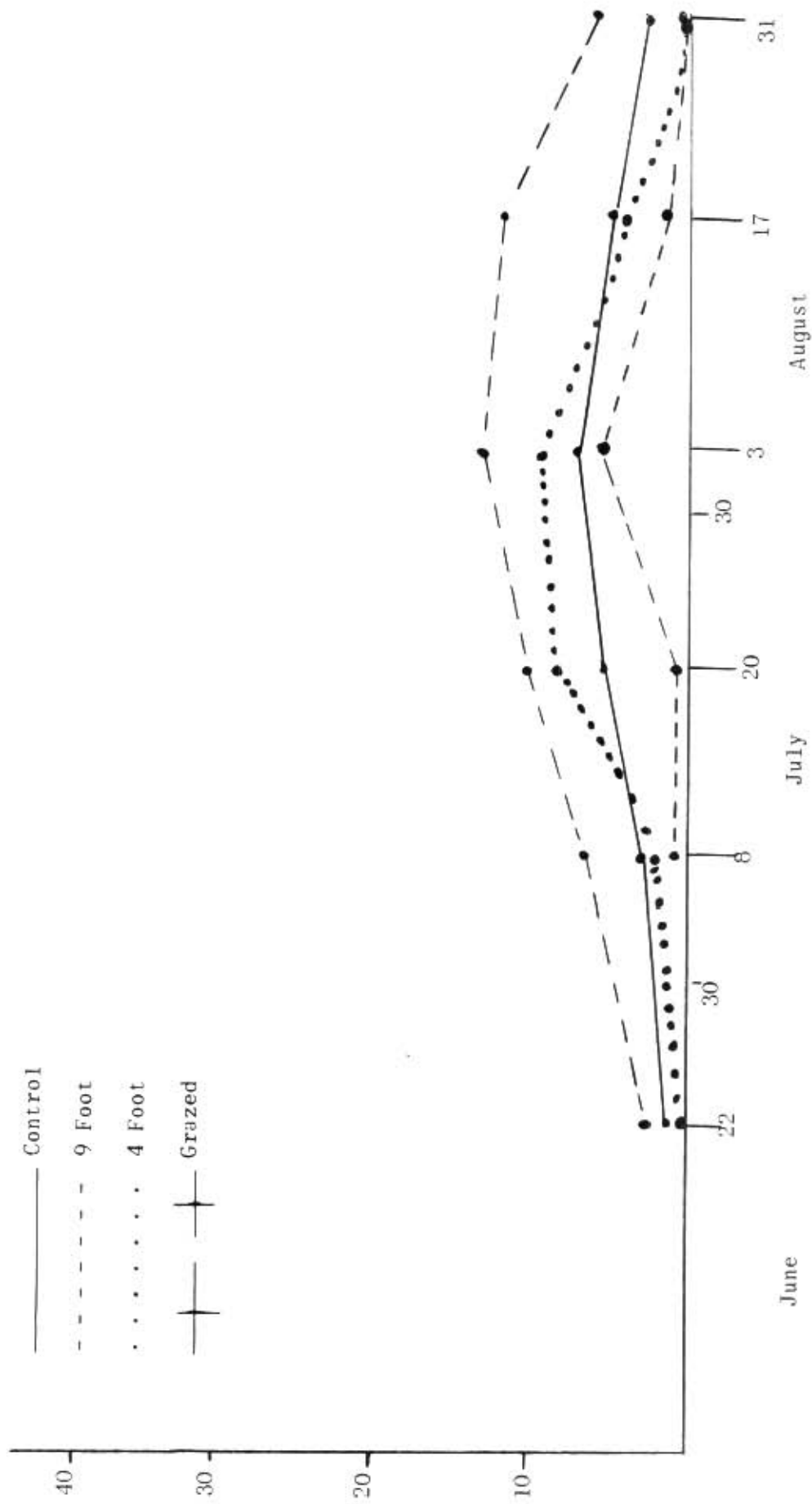


Fig. 6. *Danthonia intermedia*: Standing crop in grams per square meter, 1970 Bangtail Site.

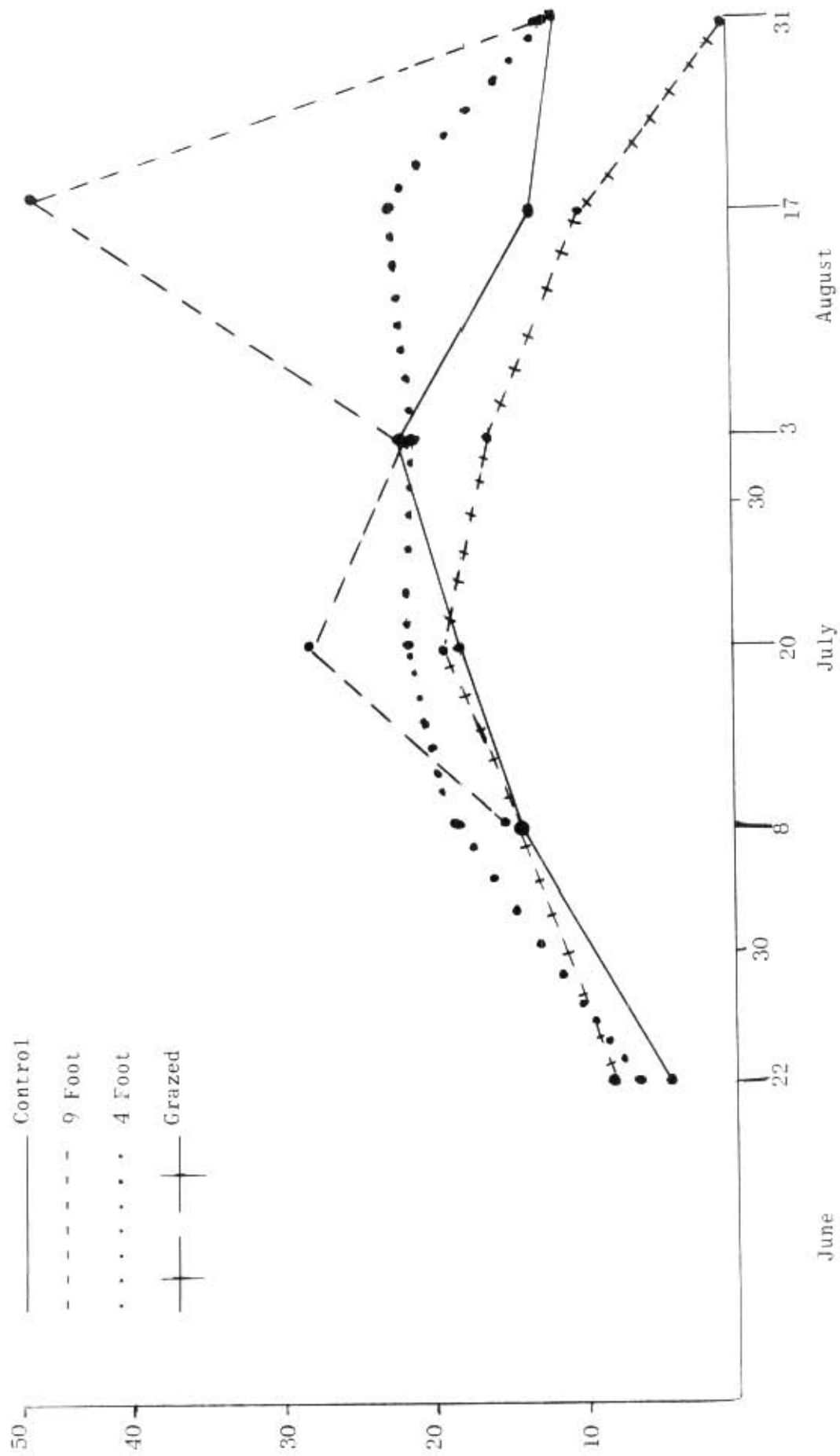


Fig. 7. *Lupinus argenteus*: Standing crop in grams per square meter, 1970 Bangtail Site.

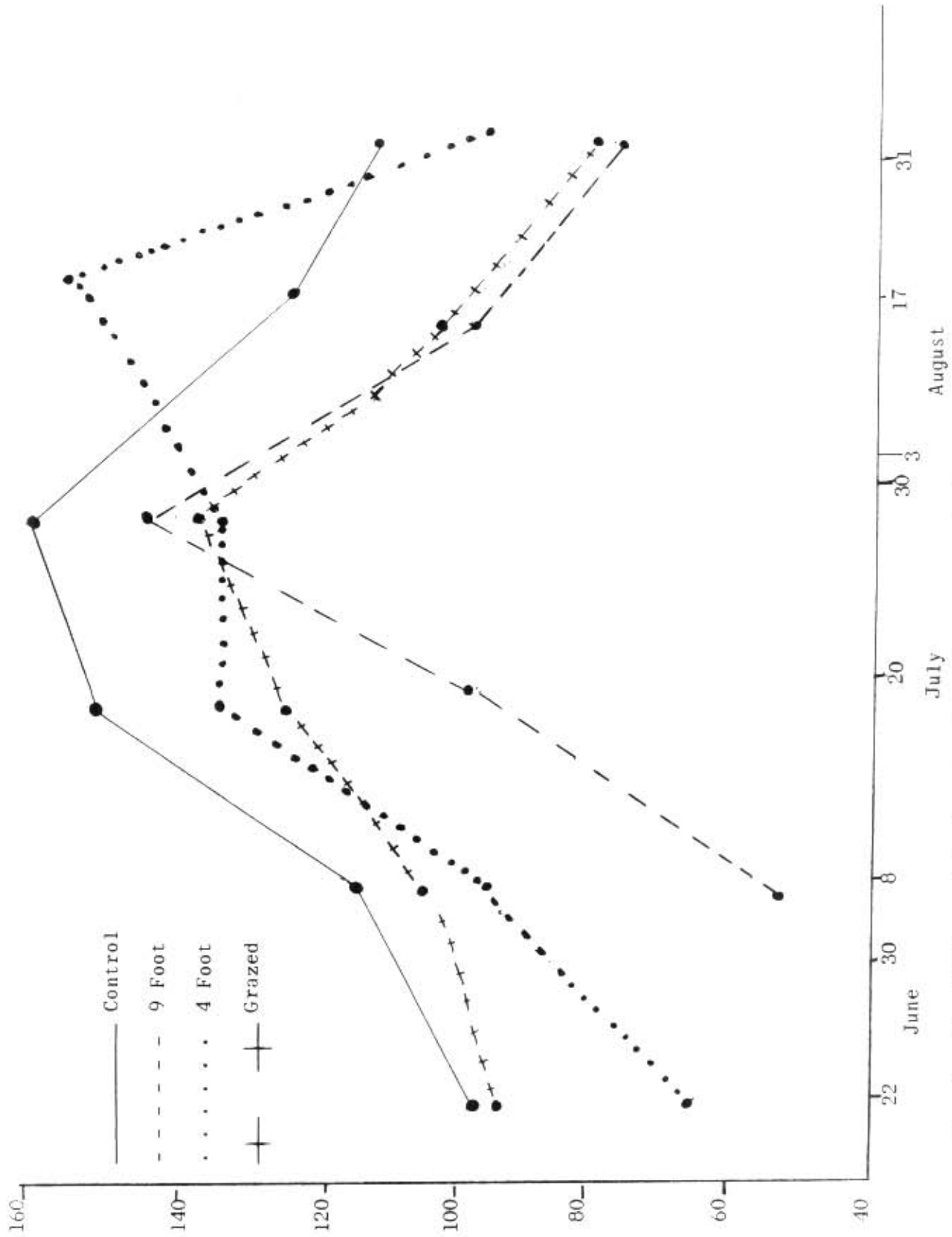


Fig. 8. Total live and dead production, 1970 Bangtail Site. Dry weight in grams per square meter.

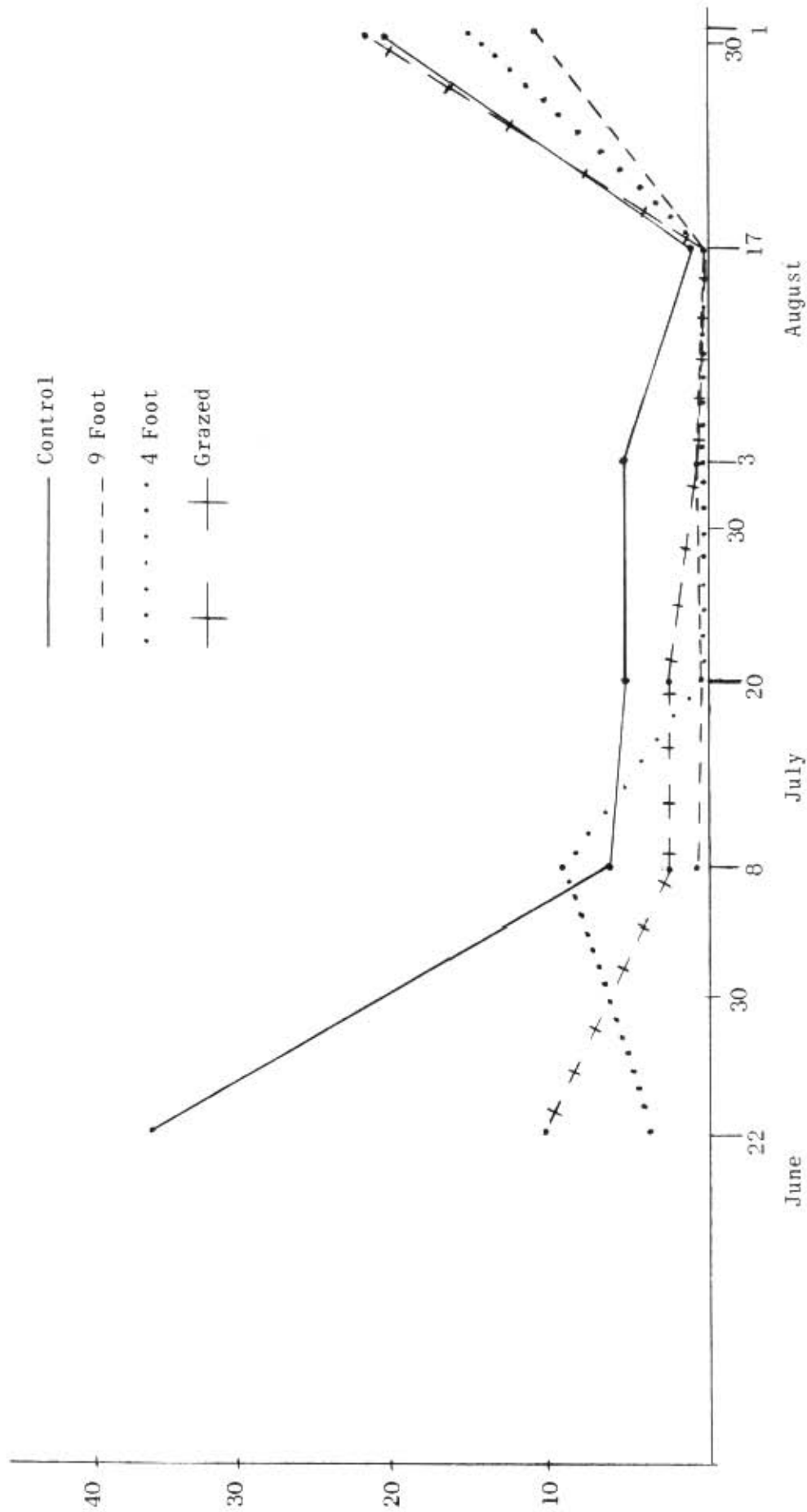


Fig. 9. Standing crop of standing dead: grams per square meter, 1970 Bangtail Site.

APPENDIX I

FIELD DATA

Aboveground Biomass Data

Aboveground biomass data collected in 1970 at the Bridger Site is Grassland Biome Data Set A2U0003. Data were collected on form NREL-01. A sample data form and a sample of the data follow.



FIELD DATA SHEET - ABOVEGROUND BIOMASS

DATE	SITE	INITIALS	DATE			TREATMENT	REPLICATE	PLOT SIZE	QUADRAT	CLIP-RANK	GROWTH FM.	GENUS	SPECIES	SUBSPECIES	PHENOLOGY	RANK	SACK NO.	DRY WT.	SPECIAL	DRY WT. SP.
			Day	Mo	Yr															
1-2	3-4	5-7	8-9	10-11	12-13	14	15	16-19	21-23	25	27	29-30	31-32	34	36-37	39-40	42-45	47-52	54-57	59-64
DATA TYPE 01 Aboveground Biomass 02 Litter 03 Belowground Biomass 10 Vertebrate - Live Trapping 11 Vertebrate - Snap Trapping 12 Vertebrate - Collection 20 Avian Flush Census 21 Avian Road Count 22 Avian Road Count Summary 23 Avian Collection - Internal 24 Avian Collection - External 25 Avian Collection - Plumage 30 Invertebrate 40 Microbiology - Decomposition 41 Microbiology - Nitrogen 42 Microbiology - Biomass 43 Microbiology - Root Decomposition 44 Microbiology - Respiration																				
SITE 01 Ale 02 Bison 03 Bridger 04 Cottonwood 05 Dickinson 06 Hays 07 Hopland 08 Jornada 09 Osage 10 Pantex 11 Pawnee																				
PHENOLOGY 01 Germinated or sprouted 02 Early vegetation 03 Prebud 04 Bud stage 05 Early bloom 06 Mid-bloom 07 Full bloom 08 Late bloom 09 Milk stage 10 Dough stage 11 Ripe seed 12 Past ripe 13 Stem cured 14 Vegetative regrowth 15 Regrowth flowering 16 Regrowth ripe seed 17 Standing dead 18 Winter dormant																				
TREATMENT 1 Ungrazed 2 Lightly grazed 3 Moderately grazed 4 Heavily grazed 5 Grazed 1969, ungrazed 1970																				
CLIP RANK 1 Harvested 2 Harvested and ranked 3 Ranked																				
GROWTH FORM 1 Perennial grass 2 Annual grass 3 Sedge, rush, etc. 4 Annual forb 5 Biennial forb 6 Perennial forb 7 Half-shrub 8 Shrub 9 Tree 0 Miscellaneous																				

+++ EXAMPLE OF DATA +++

1										2										3										4										5										6										7										8									
1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0										

010300031087011.707

1	2	6	LIAR	1	014.52
1	2	1	AGSI	2	011.59
1	2	1	FFTD	3	009.45
1	2	6	ACMT	4	001.55
1	2	0	STDFAD 19	5	004.47
1	2	1	DAIN	6	002.63
1	2	1	STRT	7	000.87
1	2	6	ARCO	8	000.19
1	2	0	MTER		011.27
1	2	0	MIGR		005.45
2	2	1	FFTD	1	013.97
2	2	6	LIAR	2	002.26
2	2	0	STDFAD 19	3	009.83
2	2	6	ACMT	4	001.04
2	2	1	DAIN	5	003.36
2	2	6	ARCO	6	001.95
2	2	0	MTER		003.02
2	2	0	MIGR		002.82
3	2	1	FFTD	1	010.33
3	2	1	DAIN	2	002.37
3	2	0	STDFAD 19	3	008.50
3	2	1	STRT	4	000.51
3	2	6	ARCO	5	000.59
3	2	6	ACMT	6	005.04
3	2	0	MTER		003.49
3	2	0	MIGR		005.29
4	2	1	FFTD	1	009.53
4	2	6	LIAR	2	004.87
4	2	6	ACMT	3	000.46
4	2	1	DAIN	4	002.67
4	2	0	STDFAD 19	5	008.49
4	2	1	AGSI	6	002.41
4	2	6	ARCO	7	000.75
4	2	0	MTER		005.48
4	2	0	MIGR		001.96
5	2	6	LIAR	1	016.37
5	2	1	FFTD	2	007.29
5	2	1	DAIN	3	001.11
5	2	0	STDFAD 19	4	007.46
5	2	6	ACMT	5	001.66

5	2	1	AGSH	6	000.19
5	2	6	AGGL	7	001.05
5	2	6	ARCO	8	001.78
5	2	0	MIFR		013.67
5	2	0	MIGR		003.81
6	2	1	FFTD	1	010.49
6	2	0	STDFAD 19	2	011.35
6	2	6	IUAP	3	003.40
6	2	6	ACMT	4	003.12
6	2	1	DATN	5	001.59
6	2	6	AGGL	6	000.49
6	2	0	MIFR		008.09
6	2	0	MIGR		001.01
7	2	1	FFTD	1	023.84
7	2	1	AGSH	2	006.61
7	2	6	IUAP	3	000.86
7	2	0	STDFAD 19	4	012.72
7	2	1	DATN	5	003.61
7	2	6	ACMT	6	001.14
7	2	6	AGGL	7	000.34
7	2	6	ARCO	8	004.93
7	2	0	MIFR		002.68
7	2	0	MIGR		003.76
8	2	6	IUAP	1	001.52
8	2	1	FFTD	2	004.17
8	2	6	ACMT	3	001.73
8	2	1	STPT	4	000.55
8	2	6	AGGL	5	001.39
8	2	1	DATN	6	001.65
8	2	0	STDFAD 19	7	002.56
8	2	0	MIFR		011.87
8	2	0	MIGR		004.61
9	2	1	FFTD	1	014.10
9	2	6	ACMT	2	002.73
9	2	6	IUAP	3	000.43
9	2	0	STDFAD 19	4	002.77
9	2	1	DATN	5	000.92
9	2	6	ARCO	6	001.16
9	2	0	MIFR		001.64
9	2	0	MIGR		004.58
10	2	1	AGSH	1	018.66
10	2	6	IUAP	2	013.55
10	2	1	FFTD	3	021.62
10	2	0	STDFAD 19	4	009.91
10	2	6	ACMT	5	001.79
10	2	6	ARCO	6	001.66
10	2	1	DATN	7	000.66
10	2	0	MIFR		017.47
10	2	0	MIGR		014.39
1	3	1	FFTD	1	
1	3	6	IUAP	2	

1	3	1	AGSU	3
1	3	0	STDEAD 19	4
1	3	6	ACMT	5
1	3	1	DATN	6
1	3	6	ARCO	7
2	3	1	FEID	1
2	3	1	AGSU	2
2	3	6	LUAR	3
2	3	0	STDEAD 19	4
2	3	6	ACMT	5
2	3	1	DATN	6
2	3	6	ARCO	7
3	3	1	FEID	1
3	3	1	AGSU	2
3	3	6	LUAR	3
3	3	6	ACMT	4
3	3	0	STDEAD 19	5
3	3	6	ARCO	6
4	3	1	FEID	1
4	3	6	LUAR	2
4	3	1	AGSU	3
4	3	1	DATN	4
4	3	0	STDEAD 19	5
4	3	6	ACMT	6
4	3	6	ARCO	7
5	3	1	FEID	1
5	3	6	LUAR	2
5	3	0	STDEAD 19	3
5	3	6	ACMT	4
5	3	6	ARCO	5
6	3	1	FEID	1
6	3	6	LUAR	2
6	3	0	STDEAD 19	3
6	3	1	DATN	4
6	3	6	STPA	5
6	3	1	AGSU	6
6	3	6	ACMT	7
6	3	6	ARCO	8
7	3	1	FEID	1
7	3	6	LUAR	2
7	3	0	STDEAD 19	3
7	3	1	AGSU	4
7	3	1	DATN	5
7	3	6	ACMT	6
7	3	6	ARCO	7

Litter Data

Litter data collected in 1970 at the Bridger Site is Grassland Biome Data Set A2U0013. Data were collected on form NREL-02. A sample data form and a listing of the data follow.

GRASSLAND BIOME

U.S. INTERNATIONAL BIOLOGICAL PROGRAM

FIELD DATA SHEET - LITTER

[illegible]

20300003087031.707	002	1	011.32
	003	1	025.26
	004	1	014.72
	005	1	003.39
	006	1	004.29
	007	1	007.53
	008	1	009.43
	009	1	017.31
	010	1	004.81
20300003087032.707	001	1	004.77
	002	1	009.46
	003	1	025.64
	004	1	021.59
	005	1	005.31
	006	1	015.79
	007	1	0.
	008	1	004.75
	009	1	003.70
	010	1	015.84
0203000170870110.50	001	1	013.76
	002	1	011.36
	003	1	005.60
	004	1	024.05
	005	1	011.64
	006	1	017.49
	007	1	007.24
	008	1	022.77
	009	1	030.19
	010	1	015.90
0203000170870110.50	001	1	004.14
	002	1	002.11
	003	1	017.52
	004	1	022.47
	005	1	005.57
	006	1	004.85
	007	1	006.56
	008	1	006.12
	009	1	005.46
	010	1	007.74
0203000170870110.50	001	1	020.05
	002	1	050.79
	003	1	018.83
	004	1	026.60
	005	1	019.40
	006	1	040.26
	007	1	028.17
	008	1	051.03
	009	1	021.59
	010	1	064.76

0203000170870120.50	001	1	007.37
	002	1	038.58
	003	1	023.41
	004	1	031.98
	005	1	031.06
	006	1	024.06
	007	1	038.30
	008	1	035.92
	009	1	015.54
	010	1	023.39
0203000170870310.50	001	1	034.99
	002	1	065.05
	003	1	044.16
	004	1	052.19
	005	1	016.11
	006	1	029.00
	007	1	005.70
	008	1	025.66
	009	1	011.83
	010	1	006.54
0203000170870320.50	001	1	020.50
	002	1	008.09
	003	1	009.12
	004	1	009.79
	005	1	020.37
	006	1	004.31
	007	1	004.32
	008	1	008.71
	009	1	007.60
	010	1	011.44