

Effects of Sheep and Gophers on Meadows of the Bridger Mountains of Montana¹

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Many range technicians, stockmen, and others have advocated the control of pocket gophers (*Thomomys* spp.) on mountain meadows because it is generally believed that gophers cause poor forage conditions. This belief is supported by the results of Moore and Reid (1951) who found that gophers on Oregon meadows did cause a decline in range condition. Ellison (1946) has stated that livestock are the primary cause of deterioration of meadows and that, "There is a slight tendency for total (vegetation) production to increase where gophers are present as compared with where they are absent." These apparent contradictions indicate that more information is needed before the question can be resolved. It is generally recognized that domestic livestock are the usual cause of deterioration of mountain meadows (Ellison, 1946), although elk are also known to cause conditions that favor the increase of pocket gophers (Laycock, 1953).

This paper is a progress report of a gopher use study initiated in 1943 in the Bridger Mountains by Harold F. Heady, then of the Montana Agricultural Experiment Station.

Methods

Four plots, each 40 feet by 40 feet, were established on a south

Table 1. Precipitation for the month of June for the years preceding the sampling years of 1944, 1951, and 1956.

	June Precipitation		June Precipitation		June Precipitation
1940	6.9*	1945	7.3*	1952	4.0
1941	8.8*	1946	4.2*	1953	6.5
1942	4.9*	1947	10.1*	1954	7.8
1943	4.6*	1948	11.4*	1955	6.3
1944	12.2*	1949	6.4*	1956	1.8
		1950	5.6*		
		1951	3.1		
Totals	39.4		48.1		26.4
Averages	7.9		6.9		5.3

* Data estimated by graphing available records from climate station near the study area (6 years of record) with records from a station showing good correlation and having records for earlier years.

slope in a mixed grass and forb type that is common on similar sites throughout the Bridger Mountains (Figure 1).

The area had been heavily grazed previous to 1929. From 1929 through 1956 the meadows were moderately grazed by

sheep. A management system including one night bed grounds and camp units was used to give uniform moderate use. There were some deer and a few elk that used the range but neither of these game species was present in excessive numbers. There were no apparent effects of game animals on the areas studied.

The elevation is about 7,000 feet. Average annual precipitation at a climatic data station 5 miles from the study area was 30.7 inches. There was an annual average of 63 days with temperatures above freezing and an average annual temperature of 39°



FIGURE 1. Mixed grass and forb type that is common in meadows in the Bridger Mountains. The enclosure shown excludes both sheep and gophers.

¹This study was conducted under a cooperative agreement between the U. S. Forest Service and the Montana Agricultural Experiment Station.

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Table 2. Total numbers of stems or plants in 8 square-meter samples in each of the four treatments for the years 1944, 1951, and 1956.

	Year	Quad #1 Open to sheep and gophers	Quad #2 Closed to sheep; open to gophers	Quad #3 Open to sheep; closed to gophers	Quad #4 Closed to sheep and gophers	Grand total
Slender wheatgrass (<i>Agropyron trachycaulum</i>) *	1944	56	105	93	235	489
	1951	1,017	143	116	211	1,487
	1956	262	399	110	266	1,037
Mountain brome (<i>Bromus marginatus</i>)	1944	8	28	176	23	235
	1951	66	157	105	62	390
	1956	11	138	56	36	241
California danthonia and Timber danthonia (<i>Dan-</i> <i>thonia californica</i> and <i>Danthonia intermedia</i>) #	1944	191	116	190	98	595
	1951	604	346	570	331	1,851
	1956	126	77	229	208	640
Idaho fescue (<i>Festuca idahoensis</i>) #	1944	250	214	267	223	954
	1951	271	195	212	304	982
	1956	120	102	158	189	568
Prairie wedgescale (<i>Sphenopholis obtusata</i>) #	1944	170	124	53	75	421
	1951	8	0†	0†	0†	8
	1956	62	55	65	31	213
Timothy (<i>Phleum pratense</i>)	1944	.....	65	3	2	70
	1951	303	291	542	79	1,215
	1956	802	288	1,335	192	2,617
Kentucky bluegrass (<i>Poa pratensis</i>)	1944	77	22	31	10	140
	1951	864	1,340	2,587	1,201	5,992
	1956	2,107	2,292	4,954	1,437	10,781
Subalpine needlegrass (<i>Stipa columbiana</i>)	1944	37	22	6	7	72
	1951	21	24	12	19	69
	1956	.....	5	1	3	8
Western yarrow (<i>Achillea lanulosa</i>)	1944	339	309	457	435	1,540
	1951	584	503	860	707	2,654
	1956	293	109	1,158	530	2,090
Pale agoseris (<i>Agoseris glauca</i>)	1944	.....	.....	.....	.....	.....
	1951	574	481	598	57	1,710
	1956	80	148	415	54	697
Common pearleverlasting (<i>Anaphalis</i> <i>margaritacea</i>)	1944	32	2	.....	2	36
	1951	21	4	8	64	97
	1956	4	11	9	53	77
Orange arnica (<i>Arnica fulgens</i>)	1944	3	4	.....	39	46
	1951	264	66	22	313	665
	1956	45	22	15	371	453
Bellflower (<i>Campanula rotundifolia</i>)	1944	5	35	40	35	115
	1951	1	13	9	6	29
	1956	20	21	71	11	123
Northern bedstraw (<i>Galium boreale</i>)	1944	52	19	49	22	144
	1951	1,067	470	439	451	2,427
	1956	48	42	41	122	253
Sticky geranium (<i>Geranium viscosissimum</i>)	1944	20	9	1	38	68
	1951	34	20	31	70	155
	1956	14	15	14	60	103
Mintleaf beebalm (<i>Monarda menthaefolia</i>)	1944	52	71	99	16	238
	1951	151	466	170	58	845
	1956	92	295	149	44	580
Cinquefoil (<i>Potentilla gracilis</i>)	1944	71	2	9	11	93
	1951	36	4	16	69	125
	1956	17	3	3	65	88
Common dandelion (<i>Taraxicum officinale</i>)	1944	231	120	103	28	482
	1951	195	33	329	47	604
	1956	11	.....	28	10	49

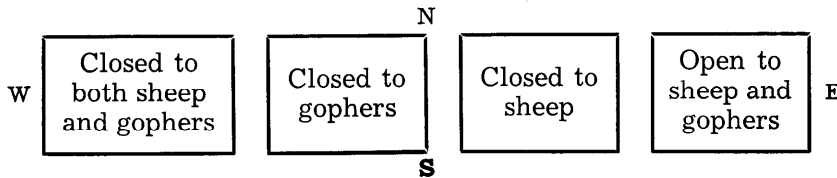
* Nomenclature of plants follows that of Kelsey and Dayton (1942).

Bunches were counted for these species. Individual stems were counted for all other species.

† Plants of this species were probably listed as *Danthonia intermedia* in 1951.

F. Precipitation for June, the highest precipitation month, is shown in Table 1.

The plots were arranged as shown in the accompanying diagram.



The open plot was marked with steel fence posts at the corners. Sheep were excluded from two plots by woven wire, and the exclusion of gophers was accomplished by burying 30-inch "hail screen" (hardware cloth) 24 inches in the ground, letting it extend 6 inches above the ground. Gophers entering the two "hail screen" exclosures by snow tunnels or other means were trapped each year.

The vegetational studies included list counts of 8 randomly selected square-meter quadrats in each treatment in 1944, 1951, and 1956. A total of 14 grass species, 45 forb species, and two shrubs plus several unidentified species were found on the plots. Only those that seemed most important are presented in Table 2. It will be noted that the numbers of stems for many species were greater in 1951 than in 1944 or 1956. The extremely dry year (Table 1) of 1956 may have caused some general reductions in stem numbers.

The data can be most easily understood by referring to Table 3 which shows the increase or decrease in each species for each treatment.

Results of statistical analyses are presented in Table 4. It is known that some differences existed in the plots when the study was initiated in 1943 (see Table 2). To avoid the influences of differences that existed when the study was initiated, the changes in plant populations between 1944 and 1956 were subjected to analyses of variance.

Results

The most striking change over the 13-year period was the increase on all plots of the two introduced species, timothy and Kentucky bluegrass. These two

surprising that these introduced species should continue to increase under protection. Possibly the meadow was somewhat deteriorated when the plots were established. Deterioration at that time is indicated by the abundance of common dandelion in 1944 (Table 2). Common dandelion decreased on all plots during the 13 years of treatment.

It would appear that gopher activity produced conditions favorable to the establishment and survival of slender wheatgrass (Tables 3 and 4). Apparently, sheep activities had little effect on this species since it increased only slightly on the plot open to sheep and closed to gophers and on the plot closed to sheep and gophers. Gophers caused a decrease in the two danthonias (*Danthonia intermedia* and *D. californica*). The contrasting responses of these grasses to gopher activities are difficult to explain. Possibly gopher mounds tended to cover the low-growing danthonias while they had little effect on the taller slender wheatgrass. The same explana-

Table 3. Changes in numbers of stems or plants during the time interval 1944 to 1956. The data are differences between totals for 8 square meters per treatment for the sampling years 1944 and 1956.

	Open	Closed to sheep	Closed to gophers	Closed
GRASSES				
Slender wheatgrass	+206	+294	+17	+31
Mountain brome	+3	+110	-120	+13
California danthonia ¹ and timber danthonia ¹	-65	-39	+39	+10
Idaho fescue ¹	-130	-113	-109	-34
Timothy	+802	+223	1,332	+190
Kentucky bluegrass	+2,030	+2,270	+4,923	+1,427
Prairie wedgescale ¹	-108	-69	+12	+43
Subalpine needlegrass	-37	-17	-5	-4
FORBS				
Western yarrow	-46	-200	+701	+95
Pale agoseris	+80	+148	+415	+54
Common pearleverlasting	-28	+9	+9	+51
Orange arnica	+42	+18	+15	+332
Bellflower	+15	-14	+31	-24
Northern bedstraw	-4	+23	-8	+100
Sticky geranium	-6	+6	+13	+32
Mintleaf beebalm	+40	+224	+50	+28
Cinquefoil	-54	+1	-6	+54
Common dandelion	-220	-120	-70	-18

¹ Bunches of these species were counted. Individual stems were counted for all other species listed.

tion might be applicable to prairie wedgescale which was also low-growing and was decreased by gopher activities.

Idaho fescue and subalpine needlegrass decreased on all plots but decreased least under complete protection. Possibly neither of these species is adapted to the local environment and are therefore being replaced by more adapted species.

Mountain brome decreased slightly due to sheep activities but increased under protection from sheep. This grass was one of the grasses most preferred by sheep (Teigen, 1949).

Western yarrow decreased on plots open to gophers and increased on the plot closed to gophers but open to sheep. Teigen (1949) found that this plant, although abundant in the area, was seldom grazed by sheep. Tryon (1947) found that western yarrow roots were frequently found in food "stores"

of gophers. Findings of these two authors help explain the response of western yarrow to sheep and gopher activities. The use of this species by gophers and the lack of use of yarrow by sheep caused marked differences in the numbers of yarrow present on the treated plots (Table 3).

Pale agoseris, although used frequently by both sheep and gophers, increased on all plots. It increased least on plots completely open or closed to both sheep and gophers. In view of the zero quantities in 1944 data, no statement can be made on its increase or decrease from 1944. The decrease from 1951 follows the general pattern of vegetational decrease. The data show major effects of gophers from 1951 to 1956. They also indicate that agoseris is a minor part of the vegetation free of gopher and sheep influences.

Of the remaining forbs, bell-

flower increased on plots open to sheep and decreased on those closed to sheep. The opposite response was true of northern bedstraw. From these results, one can assume that bellflower is not palatable to sheep while northern bedstraw is palatable to sheep.

Cinquefoil also decreased due to sheep activities and is known to be quite palatable to sheep (Teigen, 1949). Common dandelion decreased on all plots but the decrease was greatest on plots open to gophers. Common dandelion is known to be a species highly preferred by gophers (Moore, *et al.*, 1951).

Summary

The vegetational responses of 13 years of use by sheep and gophers and of protection on a mountain meadow are presented. Treatments were: (1) Protection from sheep and gophers, (2) protected from gophers, open to sheep, (3) protected from sheep, open to gophers, and (4) open to sheep and gophers.

Gopher activities caused a decrease in some of the grasses of low productivity and a decrease in two of the forbs not considered desirable on mountain range. In these respects the effects of gophers were beneficial. Species detrimentally affected by gopher activity were: Idaho fescue, California oatgrass, timber oatgrass, prairie wedgescale, subalpine needlegrass, western yarrow, and common dandelion. Gophers had a beneficial effect on slender wheatgrass.

The results presented indicate that sheep activities reduced the population of plants most preferred by sheep. This has probably made the meadow less desirable for sheep grazing but possibly more desirable as cattle range.

Sheep activities caused a decrease in mountain brome, northern bedstraw, and cinquefoil but caused an increase in timothy,

Table 4 Results of analysis of variance of changes in numbers of stems per square-meter. Treatment effects were present from 1943 to 1956.

	Results of analysis of variance of difference, 1956-1944		
	Gopher effects	Sheep effects	Gopher and sheep effects
GRASSES			
Slender wheatgrass	** ¹	ns ²	ns
Mountain brome	**	**	ns
California oatgrass and timber oatgrass	**	ns	ns
Idaho fescue	ns	ns	ns
Timothy	ns	**	* ³
Kentucky bluegrass	ns	ns	ns
Prairie wedgescale	**	ns	ns
Subalpine needlegrass	**	ns	ns
FORBS			
Western yarrow	**	**	ns
Pale agoseris	4	4	4
Common pearleverlasting	*	*	ns
Orange arnica	**	**	**
Bellflower	ns	**	ns
Northern bedstraw	ns	**	*
Sticky geranium	*	ns	ns
Mintleaf beebalm	ns	ns	ns
Cinquefoil	**	**	ns
Common dandelion	**	*	ns

¹ Indicates differences significant at the 1 percent level.

² Indicates differences not significant at the 5 percent level.

³ Indicates differences significant at the 5 percent level.

⁴ No analyses were possible for this species since no values were obtained in 1944.

Kentucky bluegrass, and bell-flower.

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