

EFFECTS OF GRAZING ON *ARABIS FECUNDA*

1996 Progress Report

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Bureau of Land Management
P.O. Box 3388
Butte, MT 59702-3388

Task Order 1422E070P60063

December 1996

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INTRODUCTION

Arabis fecunda Rollins is a rosette-forming perennial in the Mustard Family (Brassicaceae). This recently described species (Rollins 1984) is endemic to highly calcareous, azonal soils in the foothills of the Sapphire Range in Ravalli County and in the Pioneer and Highland ranges of Beaverhead and Silver Bow counties, Montana (Lesica 1993). *Arabis fecunda* generally occurs on steep, often eroding slopes with low vascular plant density. *Arabis fecunda* is considered threatened in Montana (Lesica and Shelly 1991) and is listed as a sensitive species by the U.S. Forest Service and the Bureau of Land Management.

Most sites at which *Arabis fecunda* occurs are grazed by livestock, but little is actually known about the effects of livestock grazing on this rare species. Studies have shown that *A. fecunda* is more common on soil occupied by cryptogamic soil crust (Lesica and Shelly 1992). These crusts are easily disturbed by livestock grazing; consequently, grazing may reduce *A. fecunda* populations at these sites (Lesica and Shelly 1992). Furthermore, *A. fecunda* often occurs on steep slopes with unstable soil. Trampling by livestock could reduce the number of *A. fecunda* plants on these slopes. On the other hand, *A. fecunda* seems to require open soil for seedling establishment (Lesica and Shelly 1996) and may be facilitated by disturbance associated with grazing at some sites. The purpose of this study is to determine the effects of livestock grazing on populations of *Arabis fecunda* on the north side of the Pioneer Range.

STUDY SITES

Quartz Hill: From Dewey travel west on Hwy 43 ca. 0.3 miles and then turn south on gravel road (Beaverhead Forest Road #187). Proceed ca. 1 mile up the road. Exclosure is on a steep hillside west of the road (T1S R10W S8 NW1/4 of SE1/4). Aspect: 95°, Slope: 40° Elevation: 5,900 ft.

Thompson's Corner: From Dewey, travel west on Hwy 43 ca. 3.2 miles and then turn north on gravel road (Beaverhead National Forest Road #83). Continue ca. 0.2 miles and turn east on a small dirt road along the north side of the Big Hole River. Continue ca. 2 miles. Site is on the north side of the road on the west side of a small draw. T1S R10W S5 NW1/4 of NW1/4. Aspect: 100°, Slope: 20°, Elevation: 5,600 ft.

Dewey Cemetery: From Dewey travel west on Hwy 43 ca. 0.3 miles and then turn south on gravel road (Beaverhead Forest Road #187). Proceed ca. 0.5 mile up the road to just past the

cemetery. Pull in on the small two-track going east just past the cemetery. Site is on the hill to the south. Aspect: ca. 220°, Slope: 30° Elevation: 5,800 ft.

METHODS

Field Methods

The Quartz Hill and Thompson's Corner exclosures were established in 1991, while the Dewey Cemetery exclosure was established in 1993. Measurements were made at the three sites on the following dates:

Quartz Hill- 11 Jun 1991, 7 Jun 1993

Thompson's Corner- 11 Jun 1991, 7 Jun 1993, 17 Jun 1996

Dewey Cemetery- 7 Jun 1993, 17 Jun 1996.

The Quartz Hill site was destroyed by vandals in 1995 or early 1996, before measurements could be taken a third time.

There is one exclosure plot and one control plot at each site. Each exclosure plot is 6 ft X 6 ft, marked at the four corners by metal stakes and completely covered by firm wire mesh. Control plots are placed near by the exclosure and are identical except they are uncovered. Each plot is divided into four equal subplots (3 X 3 ft) to facilitate counting.

In each subplot estimate the basal cover of rock, moss-lichen, bare ground and vegetation, and estimate the canopy cover of grass, forbs and shrubs to the nearest 5%. In each subplot count the number of *Arabis fecunda* plants in each of three size classes:

Seedling (S): single rosette smaller than a penny

Rosette (R): single rosette larger than a penny or multiple rosettes

Fruiting (F): plants with flowers or fruits

Data Analysis

Changes in basal or vegetation cover between exclosure and control plots can be assessed by visual examination of the summary tables.

There are no replicates of the treatments at any of the sites; thus, statistical tests based on parametric distributions (e.g. t-test, analysis of variance) cannot be used. It is necessary to use counts (frequency) and contingency table analysis. The ratio of *Arabis fecunda* plants in treatment to control plots in year t can be compared to that in year $t+a$ with a chi-square test. This test assumes that the observations are independent; i.e., the plants counted in year $t+a$ cannot be the same as those counted in year t . Demographic monitoring studies from low-

elevation sites indicate that ca. 65% of cohorts have died after three years (Lesica and Shelly 1995). Thus, the test cannot be considered valid unless comparing counts taken at least three years apart. Number of plants in each of the three size classes can also be compared using the same test.

RESULTS

Changes in vegetation

Canopy cover of grass has increased in all the exclosure plots since the start of the study but not in control plots (Table 1). Other changes are small and inconsistent and likely due to recording error.

Arabis fecunda density

Only the 1991-96 and 1993-96 intervals can be tested for statistical significance. The 1991-93 interval is too short because well over 50% of plants alive in 1993 were probably also alive in 1991 (Lesica and Shelly 1995).

At Thompson Corner density of *A. fecunda* increased in exclosure plots but not in control plots in 1991-96 and the difference was significant for reproductives and total density (Fig. 2). The difference between exclosure and control plots was greater in 1993 than in 1996. At Dewey Cemetery density of *A. fecunda* increased in both exclosure and control plots in 1993-96, but the increase was significantly more pronounced in the exclosure for rosettes and total density (Fig. 2). At Quartz Hill density of *A. fecunda* was higher in the exclosure in 1991, but higher in the control in 1993. Unfortunately the significance of these changes cannot be tested statistically.

DISCUSSION

In the first years of the study density of *A. fecunda* became significantly greater in the exclosures at both Thompson Corner and Dewey Cemetery, and most of this difference was due to increases in the number of rosettes, indicating enhanced recruitment following cessation of grazing. At Thompson Corner, the only site with three recording periods, the difference between exclosure and control plots remained relatively stable between 1993 and 1996. On the other hand, density of *A. fecunda* appeared to decrease in the exclosure plot relative to the control at Quartz Hill. The reason(s) for this difference in response among the three sites is not known. These results suggest that grazing or trampling have an adverse effect on *A. fecunda* populations at some but not all sites. Grass cover increased in the exclosures at all sites as expected, suggesting that livestock do use these areas. However, mule deer are also present, and there is no

way to ascertain whether the positive effect of the exclosures on *A. fecunda* was due to exclusion of cattle or deer or both.

Experimental plots at Thompson Corner and Dewey Cemetery should be visited again in 1999 to determine if the positive effect of the exclosures on *A. fecunda* continue to be manifest.

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Table 1. Basal and canopy cover of ground and vegetation in enclosure and control plots at three study sites. Litter cover is combined with bare ground.

Quartz Hill

	Enclosure			Control		
	1991	1993	1996	1991	1993	1996
Rock	0	13	--	0	10	--
Bare Ground	--	73	--	--	83	--
Moss/lichen	--	2	--	--	1	--
Basal Veg.	--	14	--	--	8	--
Grass	0	19	--	4	8	--
Forbs	3	25	--	4	14	--
Shrubs	2	8	--	3	1	--

Thompson's Corner

	Enclosure			Control		
	1991	1993	1996	1991	1993	1996
Rock	48	50	34	34	36	20
Bare Ground	--	31	18	--	53	60
Moss/lichen	--	4	3	--	3	<1
Basal Veg.	--	15	18	--	9	14
Grass	9	45	63	8	11	11
Forbs	8	26	10	8	23	14
Shrubs	0	0	0	2	2	2

Dewey Cemetery

	Enclosure			Control		
	1991	1993	1996	1991	1993	1996
Rock	--	41	16	--	38	29
Bare Ground	--	54	68	--	58	64
Moss/lichen	--	1	2	--	1	<1
Basal Veg.	--	5	8	--	5	4
Grass	--	10	23	--	5	8
Forbs	--	5	18	--	5	8
Shrubs	--	0	0	--	0	0

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Grass	--	10	23	--	5	8
Forbs	--	5	18	--	5	8
Shrubs	--	0	0	--	0	0

Figure 1. Photographs of the Quartz Hill site and enclosure taken in June, 1996.

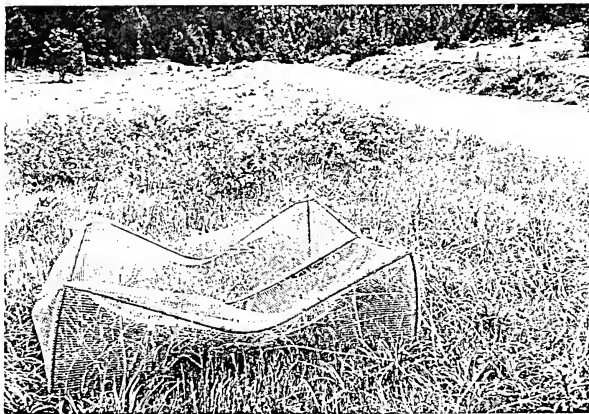
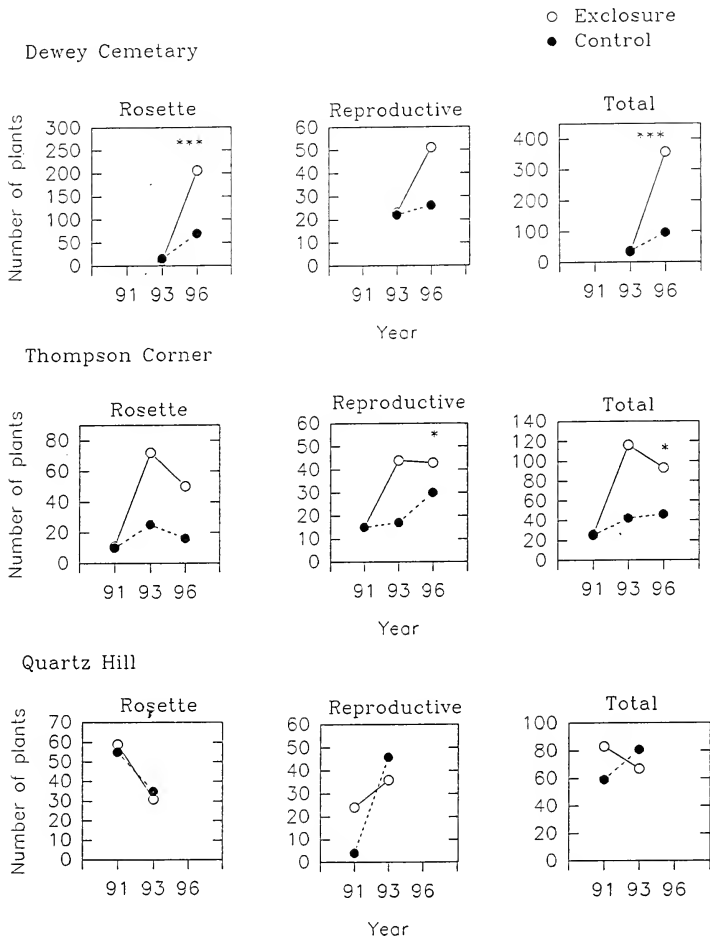


Figure 2. Density of *Arabis fecunda* in enclosure and control plots at three sites in 1991-96. Statistical significance determined by chi-square tests * $P < 0.05$, *** $P < 0.001$.



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