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EFFECTS OF GRAZING ON ARABIS FECUNDA

1993 Progress Report

Peter Lesica  
929 Locust  
Missoula, MT 59802

and

Montana Natural Heritage Program  
State Library  
1515 E. 6th Avenue  
Helena, MT 59620

Prepared for:

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

Agreement No. E950-A1-0006, No. 22

November 1993

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This document should be cited as follows:

Lesica, P. 1993. Effects of grazing on Arabis fecunda, 1993  
Progress Report to Bureau of Land Management, MT. Montana Natural  
Heritage Program, Helena. 6 pp. plus appendices.

## 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 1985, 1992, Schassberger 1988). Arabis fecunda generally occurs on steep, often eroding slopes with low vascular plant density. Arabis fecunda is a candidate for listing as a threatened or endangered species by the U.S. Fish and Wildlife Service (USDI-FWS 1993) and is considered threatened in Montana (Lesica and Shelly 1991).

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. Recent 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, submitted) and may be facilitated by disturbance associated with grazing. 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.

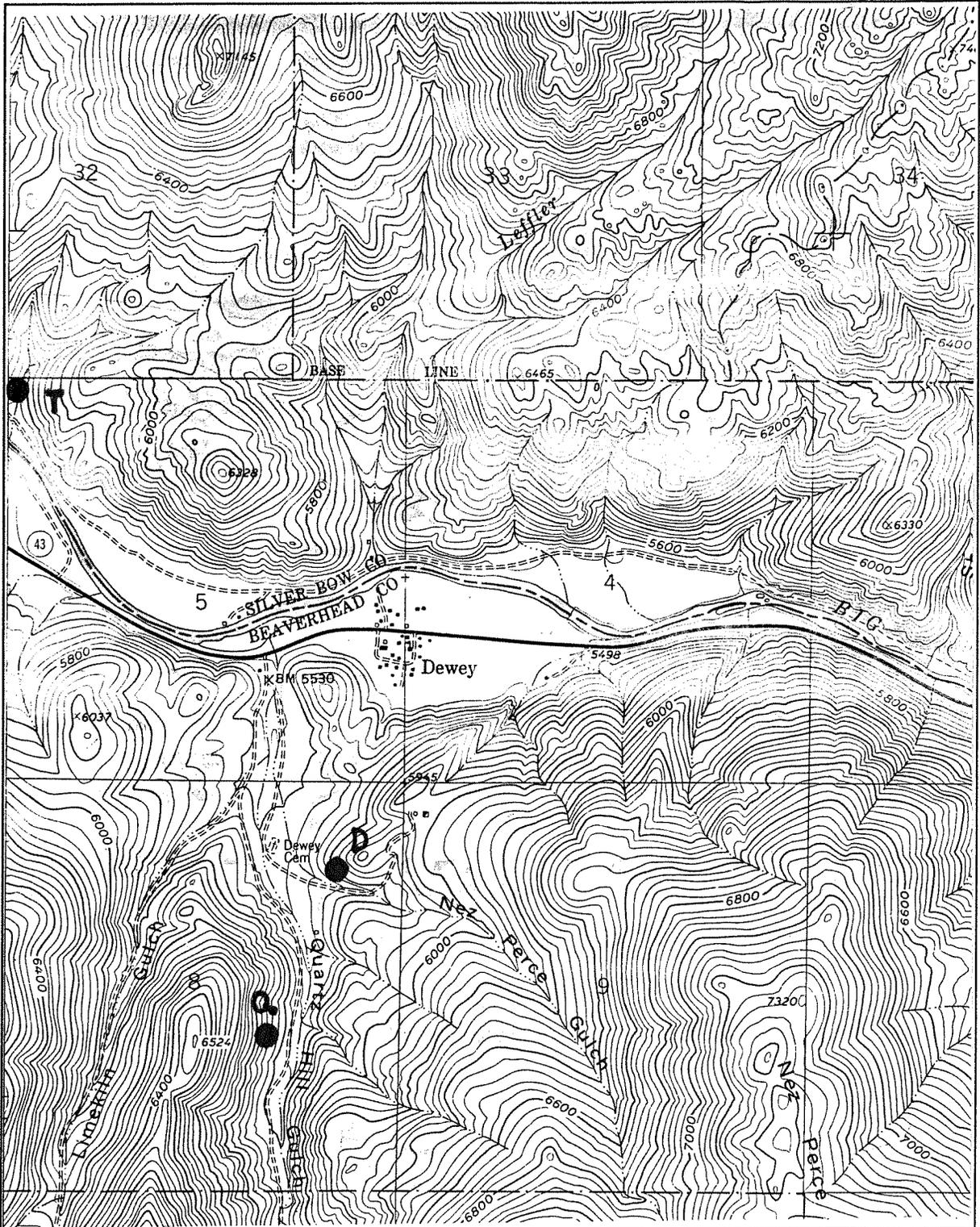
This report describes progress and addition of a sample site to the management response monitoring study set up by Schassberger (1992).

## STUDY SITES

Locations of the study sites are shown in Figure 1.

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



**Figure 1.** Location of Quartz Hill (Q), Thompson's Corner (T) and Dewey Cemetery (D) study sites.

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 and read on 11 June 1991. They were read again on 7 June 1993. The Dewey Cemetery exclosure was established and read on 7 June 1993.

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 year  $t$  to that in year  $t+a$  in the exclosure can be compared to the ratio from

the control plot 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 65% of cohorts have died after three years. 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 AND DISCUSSION

Exclosures at the Quartz Hill and Thompson's Corner sites were established in 1991; thus, a valid statistical analysis cannot be performed on these two sites until 1994. Nonetheless, examination of the data is instructive. Grass cover increased more noticeably in the exclosure plots compared to the control plots. At Quartz Hill the number of A. fecunda plants decreased in the exclosure but increased outside of it between 1991 and 1993 (Table 1). The two ratios: 83/67 and 59/81 are significantly different ( $X^2=5.04$ , " $p$ "=0.025). At Thompson's Corner there were more A. fecunda plants in both exclosure and control plots in 1993 compared to 1991, but the increase was much greater inside the exclosure (Table 2) The ratios 26/116 and 25/42 are significantly different ( $X^2=8.91$ , " $p$ "=0.003). The statistical tests are invalid for reasons given above; however, it appears that the treatment had opposite effects at the two sites. It is recommended that all three sites be sampled synchronously in 1994 if a premium is placed on getting results as soon as possible, or else that all three sample sets be scheduled for sampling in 1996.

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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

	Exclosure		Control	
	1991	1993	1991	1993
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

	Exclosure		Control	
	1991	1993	1991	1993
Rock	48	50	34	36
Bare Ground	--	31	--	53
Moss/lichen	--	4	--	3
Basal Veg.	--	15	--	9
Grass	9	45	8	11
Forbs	8	26	8	23
Shrubs	0	0	2	2

Dewey Cemetery

	Exclosure		Control	
	1991	1993	1991	1993
Rock	--	41	--	38
Bare Ground	--	54	--	58
Moss/lichen	--	1	--	1
Basal Veg.	--	5	--	5
Grass	--	10	--	5
Forbs	--	5	--	5
Shrubs	--	0	--	0

Table 2. Density of Arabis fecunda plants in three size classes in exclosure and control plots at study sites in 1991 and 1993. Size classes are seedling (S), rosette (R) and fruiting (F).

Quartz Hill									
	Exclosure				Control				
	<u>S</u>	<u>R</u>	<u>F</u>	<u>Total</u>	<u>S</u>	<u>R</u>	<u>F</u>	<u>Total</u>	
1991	--	59	24	83	--	55	4	59	
1993	24	7	36	67	14	21	46	81	

Thompson's Corner									
	Exclosure				Control				
	<u>S</u>	<u>R</u>	<u>F</u>	<u>Total</u>	<u>S</u>	<u>R</u>	<u>F</u>	<u>Total</u>	
1991	--	15	11	26	--	15	10	25	
1993	15	29	72	116	2	15	25	42	

Dewey Cemetery									
	Exclosure				Control				
	<u>S</u>	<u>R</u>	<u>F</u>	<u>Total</u>	<u>S</u>	<u>R</u>	<u>F</u>	<u>Total</u>	
1993	0	11	23	34	0	15	22	37	

