A PRELIMINARY REPORT ON THE EFFECTS OF A DEFERRED-ROTATION GRAZING SYSTEM ON WILDLIFE AT THE SHELDON NATIONAL WILDLIFE REFUGE

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ABSTRACT

This study was conducted on the Badger Mountain grazing allotment of the Sheldon National Wildlife Refuge (NWR), Nevada where a 925-acre (375 ha) cattle exclosure was built to evaluate grazing impacts. The study objectives were to measure the effects of grazing on: 1) small mammal numbers and reproduction, 2) passerine bird numbers and habitat use, and 3) mule deer (Odocoileus hemionus) food habits and dietary quality. Deer mice (Peromyscus maniculatus), least chipmunks (Tamias minimus), and Great Basin pocket mice (Perognathus parvus) comprised over 90% of 601 small mammals caught in snap traps. Sagebrush voles (Lagurus curtatus) occurred in small numbers, primarily within the cattle exclosure. Numbers of other small mammal species were comparable inside and outside the exclosure. Passerine bird numbers were similar between the exclosure and grazed site, with Brewer's sparrows (Spizella breweri) and green-tailed towhees (Pipilo chlorurus) the most numerous species (24% and 14%, respectively, of 425 individuals counted). Diversity of birds was lowest in the shrubby rolling hills and mahogany rocklands ecosites and greatest in the edge between the two. Food habits of two tame mule deer were observed in six feeding pens. Deer ate similar foods during the pre-cattle grazing trial, but they selected a greater percentage of forbs and grasses inside the exclosure during the post-cattle grazing trial. A multiresource approach to studying the effects of grazing on wildlife and their habitats provides the manager more options when managing the grazing system.

INTRODUCTION

The Sheldon National Wildlife Refuge (NWR) encompasses 575,000 ac (2,328 km^2) of the Great Basin in the northwestern corner of Nevada. Terrain on the refuge is described as "flat, open expanses of sagebrush lands, narrow canyons that empty into rolling valleys, and broad rimrock tables that end abruptly in vertical cliffs" (Sheldon National Wildlife Refuge 1980:1). Precipitation averages 13 in (33 cm) annually, winter temperatures average 21-26 degrees F (-6 to -3 degrees C) and summer temperatures average 80 - 86 degrees F (27-30 degrees C). Average elevation of the refuge is 6,000 ft (1,830 m).

The refuge is composed of 13 range sites. The 5 major sites include: 1) shrubby rolling hills (12.5% of the refuge) dominated by antelope bitterbrush (Purshia tridentata), 2) stony terrace (16.3%) dominated by low sagebrush (Artemisia arbuscula), 3) claypan terrace (17.4%) dominated by low sagebrush, 4) arid rolling hills (11.1%) dominated by big sagebrush (Artemisia tridentata), and 5) arid loamy terrace (16.7%) dominated by big sagebrush (Sheldon National Wildlife Refuge 1980).

Cattle grazing is the major economic use on Sheldon NWR and has the greatest impact on the plant and soil resources. Prior to 1976, the refuge was managed jointly with the Bureau of Land Management under guidelines established by the Taylor Grazing Act of 1936; grazing intensity by domestic cattle and by feral horses and burros was heavy during that period (Sheldon National Wildlife Refuge 1980). Since 1976, grazing has been managed solely by the Fish and Wildlife Service. The 1980 Environmental Impact Statement developed by the refuge allocated 367,000 ac. (148,701 ha) (64% of the refuge) to cattle grazing and developed new grazing management practices which altered seasons and intensity of grazing in an effort to improve range and soil conditions as well as habitats for target wildlife species.

The present study compares the effects of a deferred-rotation grazing system on wildlife and their habitats in one grazing allotment (Badger Mountain Unit) to a system of no-use by cattle. A 375-ha (925-ac) cattle exclosure was the no-use treatment. Specific objectives were to compare between the exclosure and the grazing allotment the effects of grazing on:

1) small mammal populations, reproduction, body condition, and habitat use;
2) passerine bird populations and habitat use by species, and
3) mule deer (Odocoileus hemionus) food habits and nutrient intake.

The results presented in this paper represent preliminary analysis of the data from the first year of this 4-year study.

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METHODS

Study Area

The 17,275 acres (6,954 ha) Badger Mountain grazing unit lies in the southwestern corner of the Sheldon NWR and ranges in elevation from 1,890 to 2,152 m. The unit is composed primarily of the shrubby rolling hills type interspersed with the mahogany rocklands type of which the dominant plant is curlleaf mountain mahogany (Cercocarpus ledifolius).

Prior to 1979, cattle grazed the unit on a season-long basis at an average rate of 1,700 animal unit months (AUMs). In 1979 the unit was rested. In 1980, the unit supported 1,650 AUMs over a grazing period 10 July - 10 August; in 1981, the unit supported 1,770 AUMs over a grazing period 7 August - 30 September; and in 1982, the unit supported 1,300 AUMs over a grazing period 24 June - 22 August. Sheldon range conservationist, David Franzen, mapped zones of grazing use (Anderson and Currier 1973) in the unit during October and found (pers. comm., January 1983) 45% of the unit in no-use, 26% in light use, 22% in safe-use, 7% in heavy-use, and less than 1% in severe-use categories. The management plan is to continue alternating the season of use as in 1980 - 1982. This pattern of use puts cattle onto the unit after Idaho fescue (Festuca idahoensis) has 3-4 in (7.5-10 cm) of new growth and after most bird nesting is underway. Grazing cattle on alternate years after hot weather begins should cause utilization of shrubs (Anderson 1978) and subsequently stimulate leader growth.

In May 1981, a 925 ac (375 ha) cattle exclosure was built in the southeastern corner of the Badger Mountain unit. The three-wire fence on this exclosure allows natural movement by wildlife into and out of the exclosure and restricts entrance by cattle. Because an objective of the grazing management plan is to benefit wildlife habitats, this exclosure is used to compare wildlife habitats under no-use by cattle with the grazing system. Throughout this paper, Area 1 refers to the cattle exclosure and Area 2 refers to the area outside the exclosure being grazed by cattle.

Browse Surveys

Browse cover was estimated along transect lines on the Badger Mountain Unit. Ten, 54.7 yd (50 m) transects were located in the shrubby rolling hills type (SRH), ten in the mahogany rocklands type (MR) and ten in the ecotone or edge between the two both inside the exclosure (Area 1), and immediately surrounding the exclosure (Area 2). In this study, edge is defined as the portion of a SRH stand within 5 m of a MR stand. Cover of shrubs was estimated and the number of seedlings counted in a 1.1 x 1.1-yd (1x1-m) portion of each quadrat.

Small Mammals

In July 1981, single trap lines were placed in a SRH stand in Area 1 and in Area 2 and run fo a 3 day period. The lines consisted of 20 stations separated by 50 ft (15.2 m) and containing 1 rat and 2 museum special traps. The traps were baited with a peanut butter base bait.

In 1982, small mammals were snap-trapped in the SRH ecosite along two lines inside the exclosure and two lines outside. Lines, consisting of 20 stations, were run for a 3-day period once each month from May to October, and were relocated monthly to a SRH stand at least 218 yd (200 m) away. Captured animals were frozen and taken to the laboratory where they were subsequently thawed, weighed, and the sex determined. In addition, embryos were counted and measured and testes measured.

Passerine birds

The bird community was surveyed using the variable circular-plot method (Reynolds, et al. 1980). This method involves the establishment of observation stations from which a stationary observer records all birds seen during a time controlled observation period, and records the horizontal sighting distances of each sighting.

Observation stations were established on 18 lines, separated by 164 yd (150 m); stations were spaced at 164 yd (150 m) intervals along the lines. Each of 253 stations was identified with numbered wooden stakes and flagged with surveyor's tape. Transect lines were initiated from an east-west fence line that separates Area 1 from Area 2. Each station was identified by vegetative types including SRH, MR, or edge. Area 1 contained 116 stations including 54, 18, and 44, respectively, in SRH, MR, and edge. Area 1 had 137 stations with 56, 44, and 37, respectively, in SRH, MR, and edge.

Birds surveys were conducted from 17 May to 3 June, 1982. Observers conducted the surveys from 1/2 hour before to 4 hours after sunrise; at each observation point a 1-minute quieting period was followed by a 10-minute bird observation period. For each bird we recorded area vegetative type, observer, date, plot number, sighting number, bird species, sex, time, distance, herbaceous substrate, height of sighting, distance to nearest shrub, and distance to edge.

Ater the 10-minute observation period, the observer then marked each bird sighting location (where first observed) with surveyor's flagging for future relocation for bird-habitat measurements. Habitat measurements were contingent on whether or not the bird was sighted in or near a shrub with $\geq$.3 ft (1 dm) diameter crown. Where a bird was observed in a shrub, the four nearest shrubs in each quarter of the circle around the plant were identified. If a bird was not observed in a shrub, the nearest shrub was selected as the center shrub. Each shrub, including the center shrub, was identified to species and measured for height, diameter, separation distance from the center shrub, and vigor (full canopy; full canopy but $\geq$1/2 live canopy; $<$1/2 life canopy; dead). Robel pole measurements (Robel et al. 1970), as measures of vertical stratification, were taken 5.5 yd (5 m) from the center shrub in the 4 cardinal compass directions. Height of total obscurity on the pole and highest intersection of vegetation between the observer and the pole were recorded.

Mule deer food habits

Two tame mule deer (one castrate buck and one doe) were used to determine the effects of cattle on mule deer food habits. Six pens were constructed for the feeding trials; three in Area 1 and three in Area 2. Each pen enclosed both SRH and MR ecosites in areas representative of the vegetation in the study area.

Each pen was circular with a radius of about 54 yds (47 m) and enclosed 1.8 ac (.74 ha). Eight-foot (2.4 m) wide nylon nets with 2 x 2 in (5x5 cm) mesh were hung on 10 ft. (3.0 m) fence posts located around the perimeter of the area to contain the deer during the feeding trials. The nets were removed after a feeding trial, allowing cattle and wild mule deer to move freely through the pens.

Water and rationed alfalfa hay and grain mix were available in an adjacent holding pen; however, food rations were reduced the night before the morning feeding trials. Between trials more hay and grain were available to the deer, and they were occasionally released into the pens to feed on native vegetation.

In 1982, two feeding periods were conducted in each of the six pens before (18 June-1 July), during (10 July-11 August), and after (13 August-7 September) cattle grazing. During a 2-hour feeding trial, each deer was observed by a technician who recorded plant species and number of bites taken during the full 2-hr period. During the next trial, the technicians switched deer so that each deer was observed by both technicians during the four trials in each pen.

RESULTS AND DISCUSSSION

Shrub Composition

The Badger Mountain grazing allotment is a mosaic of SRH ecosites interspersed with MR ecosites which occupy almost equal area. In the SRH, dominant shrub vegetation is sagebrush with lesser amounts of bitterbrush. Green rabbitbrush (Chrysothamnus viscidiflorus) made up less than 10% of the relative number of plants and was the third most abundant shrub. These three shrubs made up over 90% of the relative cover and number of shrub plants (Table 1A).

Curlleaf mountain mahogany was the dominant species in MR ecosites (Table 1B). Shrubs are considerably less important in MR stands, being shorter and having less coverage than in the SRH. Mountain snowberry (Symphoricarpus oreophilus) and desert gooseberry (Ribes velutinum) were most abundant in the MR and occurred only occassionally in the SRH.

The edge occurs adjacent to MR and has characteristics of both types, but is more representative of the SRH because of the definition of the type. In the edge there was little difference compared with the SRH in cover, height, and dominance of sagebrush and bitterbrush (Table 1C).

Small Mammals

Six hundred and one small mammals, representing nine species, were captured in 4,320 trap nights from May through October 1982 (Table 2). Both total number caught and number caught per species were similar between Area 1 and Area 2.

Month of capture and sex of small mammals caught at Badger Mountain are shown in Table 2. Most (62.9%) of the least chipmunks were females whereas 43.7% of the deer mice were females; both are significantly different ($P \geq 0.95$) from a 1:1 sex ratio. As the catch of deer mice increased throughout the summer, the percentage of females increased from 28.5% in July to 47.0% in September and October.

Trap success was lowest in May and June (one animal/30 trap nights), higher in July-September, and peaked in October (one animal/4 trap nights). Number of species caught peaked in July when seven species, including two species of Spermophilus were caught. Three species (deer mouse, least chipmunk, and Great Basin pocket mouse) constituted 92.7% of the total

Table 1A. Characteristics of shrubs in the shrubby rolling hills ecosite, Badger Mountain Grazing Unit, Sheldon NWR, 1982. The quadrat sample is based on 10, 1-m^2 quadrats from each of 10 transects in each area (Area 1-inside the exclosure, Area 2 outside the exclosure). The point sample is based on measurement of five shrubs around each of 54 points in Area 1 and 56 points in Area 2.

Species	Quadrat Sample				Point Sample					
	Area	% Cover/ m^2	Frequency	Average No. Seedlings/m^2	Relative Frequency	Number in vigor classes[a] 0	1	2	3	Average Height (cm)
Artemisia tridentata	1	13.0	94	0.8	59.5	22	26	61	45	56.3
	2	10.3	82	0.6	73.0	40	19	72	31	63.5
Cercocarpus ledifolius	1	0	0	0	1.5	1	0	2	1	229.8
	2	0	0	0	1	1	0	0	0	420.0
Chrysothamnus nauseosus	1	0	0	0	2.3	0	1	2	1	48.0
	2	0	0	0	1	0	1	0	0	87.0
C. viscidiflorus	1	1.1	18	0.1	7.7	0	2	8	10	31.2
	2	1.0	20	0.1	7.2	0	1	13	2	38.1
Purshia tridentata	1	9.2	76	0.5	26.3	7	0	38	23	61.2
	2	6.6	66	0.1	15.3	4	0	21	9	61.0
Ribes velutinum	1	0.1	2	0	1	0	0	1	0	61.0
	2	0	0	0	1.4	0	0	0	3	98.7
Symphoricarpus oreophilus	1	0	0	0	1	0	0	1	1	54.5
	2	0	0	0	2.3	0	1	3	1	56.6
Tetradymia canescens	1	0.3	8	0	1.5	0	0	3	1	36.5
	2	0.1	2	0	3.2	0	1	5	1	44.1

[a] Vigor Class 0 - plant dead
Vigor Class 1 - 50% live canopy
Vigor Class 2 - 50% - 100% live canopy
Vigor Class 3 - 100% live canopy

Table 1B. Characteristics of shrubs in the mahogany rocklands ecosite, Badger Mountain Grazing Unit, Sheldon NWR, 1982. The quadrat sample is based on 10, 1-m^2 quadrats from each of 20 transects in each area (Area 1-inside the exclosure, Area 2 outside the exclosure). The point sample is based on measurements of five shrubs around each of 54 points in Area 1 and 56 points in Area 2.

Species	Quadrat Sample				Point Sample					
	Area	% Cover/ m^2	Frequency	Average No. Seedlings/m^2	Relative Frequency	Number in vigor classes[a] 0	1	2	3	Average Height (cm)
Artemisia tridentata	1	0.8	38	0.4	49.4	5	0	13	26	40.5
	2	3.3	46	0.8	53.3	9	5	51	48	41.0
Cercocarpus ledifolius	1	0.1	6	0.1	13.5	7	0	4	1	246.0
	2	0.1	8	0.1	12.7	11	5	11	0	310.7
Chrysothamnus nauseosus	1	0.1	4	0.1	2.2	0	0	2	0	60.5
	2	0.2	6	0.1	1	0	0	1	0	19.0
C. viscidiflorus	1	0.1	2	0.1	3.4	0	0	2	1	37.3
	2	0.1	10	0.1	7.5	0	3	8	5	33.6
Purshia tridentata	1	0.6	46	0.9	22.5	0	0	6	14	22.2
	2	0.8	48	0.6	17.4	2	1	17	17	42.1
Ribes velutinum	1	0.6	6	0	3.4	0	0	0	3	65.0
	2	0.2	6	0	2.8	0	1	2	3	57.7
Symphoricarpus oreophilus	1	0.4	10	0.1	5.6	0	0	0	5	29.0
	2	0.1	4	0	5.2	0	0	4	7	35.2
Tetradymia canescens	1	0	0	0	1.0	0	0	1	0	-
	2	0	0	0	1.0	0	0	1	0	-

[a] Vigor Class 0 - plant dead
Vigor Class 1 - 50% live canopy
Vigor Class 2 - 50% - 100% live canopy
Vigor Class 3 - 100% live canopy

Table 1C. Characteristics of shrubs at the edge of the shrubby rolling hills and mahogany rocklands ecosites, Badger Mountain Grazing Unit, Sheldon NWR, 1982. The quadrat sample is based on 10, 1-m^2 quadrats from each of 10 transects in each area (Area 1-inside the exclosure, Area 2-outside the exclosure). The point sample is based on measurements of five shrubs around each of 44 points in Area 1 and 37 points in Area 2.

Species	Area	Quadrat Sample			Point Sample					
		% Cover/ m^2	Frequency	Average No. Seedlings/m^2	Relative Frequency	Number in vigor classes[a] 0	1	2	3	Average Height (cm)
Artemisia tridentata	1	6.6	72	1.1	54.3	21	12	38	42	53.1
	2	11.4	82	1.4	55.1	10	11	54	27	63.2
Cercocarpus ledifolius	1	0.7	12	0.1	4.8	3	2	4	1	161.0
	2	0.2	6	0	4.8	3	1	3	2	190.1
Chrysothamnus nauseosus	1	0.2	4	0	6.7	0	6	8	0	52.7
	2	0	0	0	2.2	0	2	2	0	61.0
C. viscidiflorus	1	0.7	20	0	9.1	0	2	11	6	29.3
	2	2.0	22	0.1	14.6	1	4	19	3	39.3
Purshia tridentata	1	7.5	60	0.7	20.7	2	1	21	19	55.1
	2	3.4	40	0.3	17.3	3	0	20	9	50.7
Ribes velutinum	1	0.2	6	0.1	0	0	1	0	4	-
	2	0	0	0	0	0	0	0	0	-
Symphoricarpus oreophilus	1	0.2	2	0	1.9	1	2	1	0	38.3
	2	0.1	2	0	3.8	0	2	4	1	41.3
Tetradymia canescens	1	0	0	0	2.4	0	1	4	0	44.6
	2	0	0	0	2.2	0	1	3	0	39.5

[a] Vigor Class 0 - plant dead
Vigor Class 1 - 50% live canopy
Vigor Class 2 - 50% - 100% live canopy
Vigor Class 3 - 100% live canopy

numbers caught; deer mice were the most abundant (60.7% of the total). Least chipmunks and Great Basin pocket mice constituted 63% of the relatively low catch in May and June. From August through October, deer mice were the most numerous animal caught and made up 53%-92% of the total number captured.

One transect in Area 1 and one in Area 2 were trapped in July of both 1981 and 1982 (Table 3). During both years, deer mice and least chipmunks were the most abundant species caught; however, the capture rate of all species in 1981 (one animal/2.4 trap nights) was over twice that of 1982 (one animal/5.2 trap nights).

Weights and reproductive data are shown in Table 4 for male and Table 5 for female deer mice and least chipmunks. Least chipmunks breed in late spring (Asdell 1964); our May sample reflected the last month that females were pregnant. Lactation continued into June. Eighty-eight percent of male chipmunks had testes that were less than 7 mm (0.3 in) from June through October, reflecting a non-reproductive condition. During July and August, months when we captured the greatest number of least chipmunks, weights of females did not differ between exclosures. Weights of females varied among months; July weights were lower than previous months, reflecting increased numbers of juveniles. By August, females had reached a maximum average weight, which was not statistically different ($P<0.95$) from those captured in September and October.

Reproduction of deer mice peaked in July and August when 50-100% of the females were pregnant or lactating (Table 5). By October, 5% of the females were pregnant or lactating. Weights of females were lowest in October, reflecting the increased number of young of the year in the sample. Testes length followed a similar reproductive pattern. In July, more than 84% of the males weighed more than 14 g (0.5 oz) and had testes longer than 7 mm (0.3 in). This percentage decreased through the summer and in October, 21% of the males had

Table 2. Numbers (percentage of females) caught in snap traps, 720 trapnights/month, Badger Mountain Grazing Unit, Sheldon NWR, 1982. Animals caught in Area 1 were caught inside the cattle exclosure while those in Area 2 were outside the exclosure.

Species	Area	Number captured (% females) May	June	July	August	September	October
Sorex merriami	1	0	0	0	0	0	0
	2	0	0	1(100)	0	0	0
Spermophilus townsendi	1	1(100)	1(0)	8(63)	0	0	0
	2	3(67)	0	2(50)	0	0	0
S. lateralis	1	0	0	1(0)	0	0	0
	2	0	0	3(67)	0	0	0
Tamias minimus	1	8(50)	8(63)	24(79)	21(52)	9(78)	3(100)
	2	9(67)	4(75)	35(51)	19(63)	8(63)	6(33)
Thomomys talpoides	1	0	1(100)	0	0	0	0
	2	0	0	0	0	0	0
Perognathus parvus	1	6(17)	7(71)	5(60)	4(50)	6(33)	0
	2	1(0)	1(100)	4(25)	4(50)	3(33)	0
Peromyscus maniculatus	1	2(100)	3(67)	19(32)	37(43)	49(49)	86(47)
	2	1(100)	3(33)	26(15)	27(41)	42(55)	78(42)
Microtus montanus	1	0	0	0	0	0	0
	2	0	1(100)	0	0	0	0
Lagurus curtatus	1	0	0	6(67)	4(75)	2(50)	4(50)
	2	0	0	1(0)	1(100)	1(100)	1(100)
Sylvilagus nuttalli	1	0	0	0	1(0)	3(33)	0
	2	0	0	0	1(0)	0	0
Total	1	17	20	63	67	69	93
	2	14	9	72	52	54	85

Table 3. Number of small mammals caught in 720 trapnights of snaptrapping the same lines in July 1981 and 1982, Badger Mountain Grazing Unit, Sheldon NWR. The line located in Area 1 is inside the cattle exclosure, and the line located in Area 2 is outside the exclosure.

Species	Area 1 1981	Area 1 1982	Area 2 1981	Area 2 1982
Tamias minimus	22	12	42	12
Peromyscus maniculatus	21	5	47	23
Perognathus parvus	7	2	1	3
Spermophilus townsendi	3	4	0	0
S. lateralis	1	1	0	0
Lagurus curtatus	1	3	1	1
Onychomys leucogaster	1	0	0	0
Total	56	27	91	42

Table 4. Weights and reproductive condition of male Tamias minimus and Peromyscus maniculatus, Badger Mountain Grazing Unit, Sheldon NWR, 1982. Animals caught in Area 1 were caught inside the cattle exclosure and those caught in Area 2 were outside the exclosure.

		Tamias minimus			Peromyscus maniculatus			
Month	Area	Avg. Wt. (g)	Avg. Testes Length (mm)	No. Examined	Avg. Wt. (g)	Avg. Testes Length (mm)	% with testes 7 mm	No. Examined
May	1	35.3	-	4				0
	2	32.7	-	2				0
June	1	34.3	5.3	3	21.0	9.0	0	1
	2	34.0	10.0	1	12.0	5.5	50	2
July	1	34.0	10.0	1	15.8	7.7	16.7	13
	2	31.8	4.0	5	18.8	8.3	0	22
August	1	29.8	5.3	17	17.6	8.3	15.0	20
	2	31.8	3.7	10	17.8	7.9	13.3	16
September	1	32.5	3.5	2	15.3	7.0	37.5	25
	2	30.7	3.7	3	15.8	7.5	21.0	19
October	1	-	-	0	14.0	3.2	83.7	44
	2	29.8	5.8	4	15.9	3.8	73.8	44

Table 5. Summary of weights and reproductive condition of female Tamias minimus and Peromyscus maniculatus, Badger Mountain Grazing Unit, Sheldon NWR, 1982. Area 1 is inside the Badger Mountain cattle exclosure, Area 2 is outside the exclosure.

		Tamias minimus					Peromyscus maniculatus				
Months	Areas	Avg. Wt. (g)	Avg. No. Embryos	Avg. Embryo Length (mm)	% pregnant or lactating	No. Examined	Avg. Wt. (g)	Avg. No. Embryos	Avg. Embryo Length (mm)	% pregnant or lactating	No. Examined
May	1	43.0	8.8	4.3	100	4	20.5	0		0	2
	2	38.3	8.2	4.7	100	6	34.0	6.0		100	1
June	1	44.4	0		60	5	14.5	0		0	2
	2	35.7	0		67	3	24.0	5.0	3.0	100	1
July	1	28.2	0		0	19	17.0	6.0	6.3	50	6
	2	28.2	0		8	17	22.5	5.3	3.7	100	4
August	1	33.6	0		0	11	21.8	5.7	8.6	81	16
	2	32.8	0		0	12	21.7	5.4	12.8	82	11
September	1	35.4	0		0	7	16.9	5.4	9.4	29	24
	2	32.4	0		0	5	18.2	6.0	11.6	30	23
October	1	35.0	0		0	3	14.6	0	0	5	40
	2	34.0	0		0	2	15.4	0	0	0	33

testes longer than 7 mm (0.3in); however, 57% of the males weighed more than 14 g (0.5 oz). This indicates that young non-breeding males were reaching adult size and that testes of adult males in summer had decreased in length to a non-breeding condition.

Hanley and Page (1982) evaluated the effects of grazing on small mammal communities in the Great Basin about 80 km west of our study area. In their big sagebrush/Idaho fescue type, the type most similar to our study area, they captured three species: least chipmunk, deer mouse, and sagebrush vole. Number of species caught in their grazed system was not greatly different than in their ungrazed system; however, they caught more individuals in their grazed system. Because Hanley and Page (1982) trapped in seven different habitats, it is difficult to draw conclusions about the effect of grazing on the total number of each species caught. Of the abundant species, least chipmunks and deer mice were more abundant in their grazed system overall and in three of the seven habitats. Great Basin pocket mice were more abundant in the ungrazed system, especially in the low sage/Idaho fescue type. The three species of voles they captured were more abundant in the ungrazed system, especially in grass habitats. Although we captured more sagebrush voles in Area 1, we feel that it is premature to make a judgement about the significance of our results.

Passerine birds

For the purpose of this discussion, bird observations in Areas 1 and 2 are combined. An estimate of relative abundance for all birds observed was determined for each ecosite by calculating the number of birds and species observed per hour. Species diversity was also described (Fig. 1) using the procedure of Patil and Taillie (1979). Estimates of bird densities were not calculated.

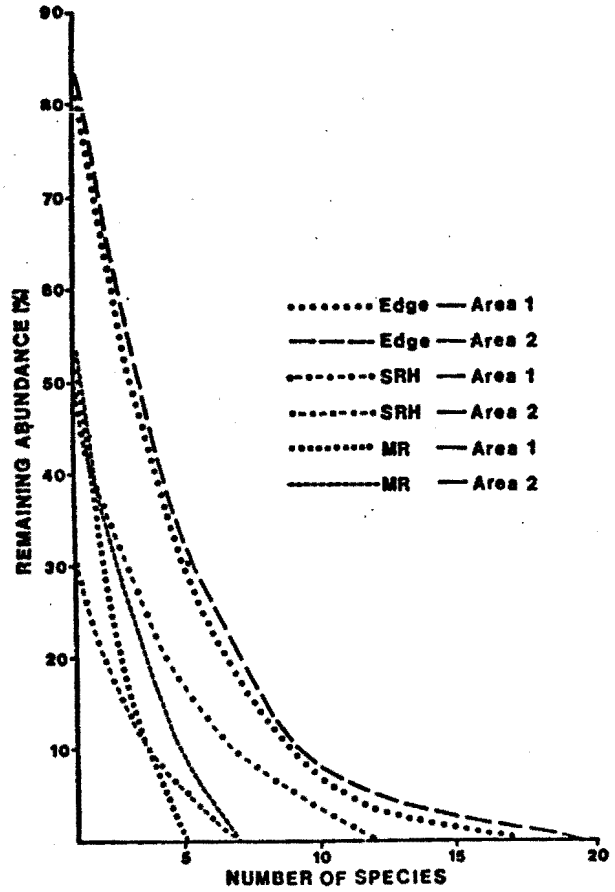

Figure 1. Diversity profiles of birds in three habitats and two areas (Area 1, inside cattle exclosure, Area 2, outside cattle exclosure), Badger Mountain Grazing Unit, Sheldon NWR, 1982. When one line does not intersect with another, the diversity represented in the two lines is different.

A total of 425 birds of 26 species were recorded from the variable circular plots (Table 6). Six additional species were observed on Badger Mountain, but not on the plots. Comparisons of the bird communities for each ecosite revealed that the edge had the greatest relative abundance (22.1 birds/hr and 1.7 spp/hr) (Table 7, Fig. 1) The SRH and MR ecosites sagebrush had the next greatest abundance, 5 birds/hr, 0.7 spp/hr and 3.4 birds/hr, 0.7 ssp/hr, respectively.

Table 6. Birds observed on the Badger Mountain Grazing Unit, Sheldon NWR, May-June, 1982. Birds with 0 observations were observed in the area but not on survey plots.

Species	253 observations on 153 variable circular plots
Turkey vulture (Cathartes aura)	0
Red-tailed hawk (Buteo jamaicensis)	1
American kestrel (Falco Sparverius)	2
Mourning dove (Zenaida macroura)	0
*Long-eared owl (Asio otus)	1
Common nighthawk (Chordeiles minor)	0
Northern flicker (Colaptes auratus)	1
Gray flycatcher (Empidonax wrightii)	1
Say phoebe (Sayornis saya)	0
Horned lark (Eremophila alpestris)	2
Violet-green swallow (Tachycineta thalassina)	0
Steller's jay (Cyanocitta stelleri)	1
Scrub jay (Aphelocoma coerulescens)	47
Common raven (Corvus corax)	0
*Mountain chickadee (Parus gambeli)	2
Bushtit (Psaltriparus minimus	5
*Rock wren (Salpinctes obsoletus	47
*Blue-gray gnatcatcher (Polioptila caerulea)	10
*Mountain bluebird (Sialia currucoides)	30
Townsend's solitaire (Myadestes townsendi)	1
*American robin (Turdus migratorius)	16
*Sage thrasher (Oreoscoptes montanus)	20
Loggerhead shrike (Lanius ludovicianus)	1
Yellow-rumped warbler (Dendroica coronata)	1
Wilson's warbler (Wilsonia pusilla)	1
*Green-tailed towhee (Pipilo chlorurus)	60
Rufous-sided towhee (Pipilo erythrophthalmus)	3
Chipping sparrow (Spizella passerina)	3
*Brewer's sparrow (Spizella breweri)	104
*Vesper sparrow (Pooecetes gramineus	6
*Western meadowlark (Sturnella neglecta)	11
*Brewer's blackbird (Euphagus cyanocephalus)	54

* Nest located.

The diversity profiles (Fig. 1) indicated that the edge was more diverse than the two pure ecosites, and that birds were more diverse in Area 2 than in Area 1 in the edge and MR. The nine most common species were more abundant in the edge (Table 7). Brewer's sparrow was the most abundant bird in both edge and SRH. Scrub jays (Aphelocoma coerulescens) were the most abundant bird observed in MR. Birds unique to one or two ecosites include the blue-gray gnatcatcher (Polioptila caerulea) for the edge, and American robin (Turdus migratorius) and sage thrasher (Oeoscoptes montanus) for the edge and SRH.

Bird communities were compared with those reported by Reid and Schroeder (1979). They reported that the five most abundant birds in arid rolling hills, the ecosite most similar to our SRH, were the Brewer's sparrow, sage sparrow (Amphispiza belli), sage thrasher, horned lark (Eremophila alpestris), and gray flycatcher (Empidonax wrightii). Comparisons with 1982 results also show Brewer's sparrows as the most abundant sagebrush bird. In 1982, the rock wren (Salpinctes obsoletus) replaced the sage sparrow, which was not observed, as the second most abundant bird in SRH. Two other differences noted in 1982 were the scarcity of horned larks and gray flycatchers.

Reid and Schroeder (1979) reported Brewer's blackbirds (Euphagus cyanocephalus) as the most abundant bird in their MR stands followed by scrub jay, Brewer's sparrow, and green-tailed towhee. Scrub jays replaced Brewer's blackbirds as the most abundant bird in 1982, but Brewer's sparrows and green-tailed towhees remained the third and fourth most abundant species.

Table 7. Relative abundance (birds/hr) in three types of nine most common avian species surveyed on variable circular plots, Badger Mountain Grazing Unit, Sheldon NWR, May-June 1982.

Species	Type		
	Edge	Shrubby rolling hills	Mahogany rocklands
Brewer's sparrow	3.5	2.8	.5
Green-tailed towhee	3.5	.4	.5
Brewer's blackbird	2.8	.3	.7
Rock wren	2.5	.5	.2
Scrub jay	2.4	.1	1.0
Mountain bluebird	2.1	.1	.1
American robin	1.2	.1	0
Sage thrasher	1.2	.2	0
Blue-gray gnatcather	.7	0	0
Total (All Species)			
Birds/hr	22.1	5.0	3.4
No. species	23	14	8

Differences noted between 1978 and 1982 may be due to seasonal variation in bird communities and to ecosite variation. Mahogany rockland stands surveyed during 1978 by Reid and Schroeder (1979) were on sites similar to our 1982 surveys but arid rolling hills stands surveyed in 1978 were at lower elevations than SRH stands we surveyed in 1982. Additional annual surveys on the Badger Mountain study site should help explain natural changes in bird community structure in addition to changes brought about by the grazing system.

Mule deer food habits

The food habits data were summarized by pen, exclosure, and treatment (before, during, and after cattle grazing) by bite counts for all plant species eaten during the feeding trials. Eleven shrub, 46 forb, and 13 grass and grasslike species comprised the 120,159 bites taken during the feeding trials (Tables 8 and 9). These results indicate a gradual trend toward more bites on fewer species from the pre- to post-grazing periods. Percentage of bites on shrub species increased throughout the summer in Area 2. Percentage of shrubs was significantly higher ($P \geq 0.95$) and of forbs lower in Area 2 than Area 1 during the post-grazing period. A higher percentage of bites were made on grass and grasslike species than on forbs during the cattle-grazing period of feeding trials.

Table 8. Plants eaten and their importance in mule deer feeding trials. Badger Mountain Grazing Unit, sheldon NWR, 1982. Importance is the number of trials (out of 18) in which the species made up ≥2% of the bites eaten in that trial.

Shrubs (11)	Importance
Amelanchier utahensis	3
Artemisia arbuscula	-
Artemisia tridentata	-
Cercocarpus ledifolius	17
Chrysothamnus viscidiflorus	-
Leptodactylon pungens	-
Purshia tridentata	18
Ribes cereum	-
Ribes velutinum	-
Symphoricarpus oreophilus	13
Tetradymia canescens	2
Forbs (46)	
Agastache urticifolia	-
Agoseris glauca	-
Antennaria geyeri	1
Antennaria spp.	-
Arabis puberula	3
Arabis spp.	2
Astragalas agretis	-
Astragalas purshii	3
Aster scopularum	-
Balsamorhiza hookeri	2
Balsamorhiza saggittata	1
Calochortus spp.	-
Castillija chromosa	-
Castillija spp.	-
Chenopodium leptophyllum	-
Collinsia parvilflora	1
Crepis acuminata	7
Cryptantha circumscissa	-
Cryptantha spp.	-
Delphinium andersonii	-
Descurainia pinnata	1
Descurainia sophia	-
Erigeron filifolius	10
Erigeron linearis	3
Eriogonum leucocladon	-
Eriogonum stricta	1
Eriogonum umbellatum	10
Frasera albicaulis	-
Fritillaria atropurpurea	-
Gayophytum ramosissimum	3
Gilia tenerrinia	-
Lomatium nevadense	8
Lithosperma ruderale	-
Lupinus spp.	-
Machaeranthera canescens	-
Mertensia oblongifolia	3
Microsteris gracilis	-
Phacelia hastata	-
Phacelia humilis	-
Phlox diffusa	2
Phoenicaulis cheiranthoides	4
Polygonum douglasii	-
Senecio canus	-
Senecio integerrimus	-
Silene douglasii	-
Viola purpurea	1
Grasses and Grasslikes (13)	
Agropyron spicatum	2
Bromus tectorum	-
Carex spp.	11
Elymus cinerus	1
Festuca idahoensis	8
Koeleria nitada	-
Melica stricta	-
Oryzopsis hymenoides	-
Poa cusickii	2
Poa spp.	4
Sitanion hystrix	17
Stipa occidentalis	17
Stipa thurberiana	4

Table 9. Composition of bites in three plant groups by tame mule deer in 18 feeding trials in Area 1 (inside the Badger Mountain Cattle exclosure) and Area 2 (outside the cattle exclosure), Badger Mountain Grazing Unit, Sheldon NWR, 1982.

Cattle Grazing Periods	Area	Plant Group: Shrubs (%)	Forbs (%)	Grass/Grasslike Species (%)	Total Bites	No. Species
Pre-Grazing	1	75	18	7	17,113	50
18 June-1 July	2	73	15	13	13,234	49
During-Grazing	1	68	12	19	21,033	47
10 July-11 August	2	80	7	13	23,060	48
Post-Grazing	1	61	27	12	21,691	43
13 August-7 September	2	83	8	9	24,227	39

Shrubs, forbs, and grass and grasslike species were ranked by importance, based on the frequency at which they were recorded as composing 2% of the bites in the feeding trials (Table 10). The four species of each plant group that were most often eaten were selected for discussion and constituted 95% of the bites recorded for the food habits study. The four shrub species constituted 99% of the total bites recorded for all shrub species eaten. The four forb and grass and grasslike species constituted 71% and 85% of the bites recorded for their respective plant groups.

Antelope bitterbrush was the most heavily eaten plant throughout the study in terms of bite counts. Bitterbrush constituted 84% and 62% of the bites recorded for shrub and total bites, respectively. During the pre-grazing period more bites on bitterbrush were recorded for the trials in Area 1 than in Area 2. The reverse was true for the grazing and post-grazing periods, with a significant difference ($P \geq 0.95$) between bite counts in Area 1 (12,080) and Area 2 (17,369) for the post-grazing period. The deer tended to select the heavily browsed or hedged plants during the early pre-grazing trials. As the feeding trials progressed, the deer selection for hedged vs. unhedged plant became less distinct. Deer tended to select current twig and leaf growth and avoid flowering parts. Young or small plants seemed to be browsed whenever encountered during the grazing and post-grazing periods.

Nine and 7% of the bites recorded for shrub species and total bites, respectively, were taken on curlleaf mountain mahogany. For the most part only hedged plants were available to the deer. The bite counts were similar between the areas during the pre- and post-grazing periods. More bites were recorded in Area 2 than Area 1 (2,156 bites vs 1,518 bites) during the cattle grazing period. When the deer came across young plants, most if not all of the current annual growth was eaten. During the post-grazing period, the deer concentrated on the dried leaves and twigs from branches knocked down while constructing the pens in June. These dried twigs were selected over leaves and twigs found on living plants.

Five and 4% of the bites recorded for shrub species and total bites, respectively were taken on mountain snowberry. A significantly higher number of bites were recorded in Area 2 than Area 1 throughout the study period. This was probably due to availability (Table 11). It did not appear that the deer actively searched for snowberry as was true with the above species, but rather came across it as it grew out from under bitterbrush and mahogany plants.

One percent of the bites for both the shrub species and total bites, respectively, were taken on Utah serviceberry (Amelanchier utahensis). Although this plant seemed to be a desirable species, it grew in only two pens and did not occur in our production sample.

Twenty and 3% of the bites recorded for forb species and total bites, respectively, were taken on threadleaf fleabane (Erigeron filifolius). This species seemed to mature later than the other forbs mentioned, and was not available to the deer during the pre-grazing period (Table 11). Threadleaf fleabane was eaten during the grazing and post-grazing periods, and a significantly higher bite count was recorded in Area 1. All parts of the plant, including roots, were consumed.

Twelve and 2% of the bites recorded for forb species and total bites, respectively, were taken on sulphur flower (Eriogonum umbellatum). More bites were taken in Area 1 (1,224) than in Area 2 (811). Through the pre- and early-cattle grazing periods, the deer fed almost exclusively on the inflorescence and ignored the green leafy growth. As the inflorescence dried more leaves were eaten and eventually only leaves were available.

Twenty-one and 3% of the bites recorded for forb species and total bites, respectively, were taken on Nevada biscuit-root (Lomatium nevadense). This species was the most sought after forb throughout the pre-grazing period and all plant parts were consumed. More bites were recorded in Area 1 (2,430) than in Area 2 (1,141). Few bites of Nevada biscuit-root were recorded for the feeding trials after July 22, when no green material was left on the plants.

Eighteen and 3% of the bites recorded for forbs and total bites, respectively, were taken on tapertip hawksbeard (Crepis acuminata). As with all of the above mentioned forbs species, more bites were taken in Area 1 (2,496) than in Area 2 (570). Bite counts indicate this

species was fed upon heavily through the post-grazing period, moderately during the cattle-grazing period, and lightly for the pre-grazing period. This species seemed to be preferred primarily during the seed-scatter and plant-drying phenological stages, and dried inflorescences and leaves were the preferred parts of the plant.

Thirty-four and 4% of the bites recorded for grass and grasslike species and total bites, respectively, were taken on western needlegrass (Stipa occidentalis). We recorded higher bite counts in Area 2 (216) than in Area 1 (138) during the pre-grazing period. The reverse occurred for the grazing (2,003 in Area 1, 1,323 Area 2) and post-grazing periods (849, Area 1 and 514, Area 2). Before anthesis, a large percentage of bites consisted of seed heads. Seed heads were avoided after they began to dry. Although there were western needlegrass plants not utilized by cattle in Area 2, the deer tended to select those plants previously utilized by the cattle during the grazing and post-grazing periods.

Nineteen and 2% of the bites recorded for grass and grasslike species and total bites, respectively, were taken on squirreltail (Sitanion hystrix). No major differences between bite counts between Area 1 and Area 2 were observed during the feeding trials. The highest bite counts occurred during the pre-cattle grazing trials and decreased through the grazing and post grazing trials (Table 10). While the plants were green, leaves, culms and seed heads were eaten. Seed heads and culms were avoided during the post anthesis and seed head drying phenological stages.

Twenty-four and 3% of the bites recorded for grass and grasslike species and for total bites, respectively, were taken on sedges (Carex spp.). Higher bite counts were recorded in Area 2 throughout the study. More bites were taken as the feeding trials progressed through the summer (Table 10). Sedges seemed to stay green longer, throughout the season, compared to the grass species.

Table 10. Bite counts of the 4 most important species in each plant group by grazing period and area during 1982 mule deer feeding trials, Badger Mountain Grazing Unit, Sheldon NWR.

Species	Pre-Grazing[1] Area 1[4]	Pre-Grazing[1] Area 2[5]	During-Grazing[2] Area 1	During-Grazing[2] Area 2	Post-Grazing[3] Area 1	Post-Grazing[3] Area 2
Shrubs						
Purshia tridentata	11,095	7,441	12,698	14,104	12,080	17,369
Cercocarpus ledifolius	1,376	1,326	1,518	2,156	709	743
Symphoricarpus oreophilus	393	732	166	1,436	394	1,622
Amelanchier utahensis	0	69	0	727	0	30
Forbs						
Erigeron filifolius	0	0	533	83	2,279	438
Eriogonum umbellatum	237	379	608	298	104	409
Lomatium nevadense	2,052	1,024	340	104	38	13
Crepis acuminata	49	31	328	121	2,119	418
Grass & Grasslike Species						
Stipa occidentalis	138	216	2,003	1,323	849	514
Sitanian hystrix	720	588	464	414	274	272
Carex spp.	377	145	251	713	813	1,141
Festuca idahoensis	94	101	352	282	227	121

1 18 June - 1 July
2 10 July - 11 August
3 13 August - 7 September
4 Inside cattle exclosure
5 Outside cattle exclosure

Table 11. Production (g/m^2) of shrubs, forbs and grasses in six deer feeding trial pens, Badger Mountain Grazing Unit, Sheldon NWR, 1982.

Species	Pre-Grazing[1]		During-Grazing[2]		Post-Grazing[3]	
	Area 1[4]	Area 2[5]	Area 1	Area 2	Area 1	Area 2
Shrubs						
Purshia tridentata	10.2	13.7	18.1	15.0	20.1	13.0
Cercocarpus ledifolius	0	1.9	0.3	4.7	0.1	0.2
Symphoricarpus oreophilus	0	0.2	0	0.5	0.1	0.6
Amelanchier utahensis	0	0	0	0	0	0
Total Shrubs	43.9	45.5	72.8	61.3	59.4	47.0
Forbs						
Erigeron filifolius	0	0	0.2	0.1	0.1	0
Eriogonum umbellatum	0.1	0	0.3	0	0.1	0
Lomatium nevadense	0.6	0.8	0.2	0.2	0.2	0.1
Crepis acuminata	0.2	0.7	0.8	0.3	0.4	0.5
Total Forbs	9.9	7.9	9.3	5.8	7.0	5.1
Grass & Grasslikes						
Stipa occidentalis	8.1	6.0	5.7	5.4	8.8	3.0
Sitanion hystrix	3.3	4.6	4.3	6.0	5.0	4.1
Carex spp.	0.2	0.6	0.1	1.3	0.1	0.8
Festuca idahoensis	15.7	10.5	16.9	14.5	7.8	10.0
Total Grasses	39.6	30.2	39.1	33.9	35.9	21.6

1 18 June - 1 July
2 10 July - 11 August
3 13 August - 7 September
4 Inside cattle exclosure
5 Outside cattle exclosure

Eight and 1% of the bites recorded for grass and grasslike species and total bites, respectively, were taken on Idaho fescue. More bites were taken in Area 1 (673) than in Area 2 (504). The highest bite counts occurred during the cattle grazing period, and the fewest occurred in the pre-grazing period. During the pre-grazing and grazing periods, seed heads were the primary plant part consumed.

Kufeld et al. (1973) reported seasonal use on 10 of the 12 species which made up 95% of the foods eaten in our feeding trials. They reported moderate to high levels of use of bitterbrush and curlleaf mountain mahogany and moderate levels of use of snowberry. The important non-browse species eaten in our feeding trials were not listed by Kufeld et al. (1973) as being important summer forage. Tueller (1979) reported similar results to those of Kufeld et al. (1973). Tueller's Fox Mountain study site is probably most similar to ours and he reported high summer usage of bitterbrush and curlleaf mountain mahogany but little use of non-browse species. Tueller reported that average composition of browse in the diet of Fox Mountain deer was 89.7%. This value is probably biased toward browse because he used rumen analysis rather than direct observations. It is noteworthy, however, that grasses and forbs comprised less than 6% of the deer's diet at Fox Mountain.

CONCLUSIONS

The results presented here are preliminary and based on 1 year of research. At present, no firm conclusions may be reached regarding the effect of cattle grazing on wildlife and their habitats in this deferred rotation grazing system where over 92% of the unit is in safe-, light-, and no-use grazing intensities. However, some patterns exist. Whereas the most numerous small mammal species do not appear to differ between areas, sagebrush voles were more numerous in Area 1 than Area 2. This species prefers greater coverage of grass and our forage availability samples in the deer feeding pens (Table 11) indicate greater biomass of grasses in Area 1 than Area 2 after cattle were removed from the allotment. After two years of cattle exclusion, we would expect the greater production of grass as shown in Table 11 and a greater amount of residual grass cover which should be conducive to higher numbers of both sagebrush and montane voles. We do not know how much of a change in cover is required to observe statistically significant differences in those populations between Areas 1 and 2. Future research will evaluate differences in herbaceous cover between the two areas and attempt to relate these differences to vole abundance.

The pattern of forbs eaten in the deer feeding trials leads to interesting speculation. Our sampling effort in measuring forage availability was not adequate to precisely describe availability in each pen and we have not yet calculated biomass intake of the deer. However, the great difference in the percentage of forbs eaten in Area 1 compared with Area 2 in the post-grazing feeding trial lead us to believe that a real difference exists. Several factors may produce different results in future years of study. We anticipate using different deer each year to evaluate variability of food preferences. During the summers of 1983 and 1985, our deer trials will be conducted later in the summer and extend into November to correspond with the season of cattle grazing. We expect to observe some differences in food selection due to differences in plant phenology which may not be related to the effect of cattle use of the forage.

No grazing system can, nor can the absence of grazing, be beneficial to all species of wildlife and to the plant species occupying the range. However, with additional research, we believe the approach we have taken in this study will provide more options for the manager when evaluating the effects of the grazing system on wildlife and their habitat.

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