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Grazing, Crested Wheatgrass, and Bird Populations in Southeastern Idaho

Abstract

Populations of nesting and non-nesting birds were examined and compared in grazed and ungrazed habitats dominated by sagebrush and crested wheatgrass. Sheep grazing in a sagebrush community did not alter the density or the diversity of nesting bird populations. Planting a former sagebrush range with crested wheatgrass, with or without grazing pressures, reduced the diversity and abundance of nesting species. More species and individuals of migrant and non-nesting birds used the sagebrush habitats than the crested wheatgrass plantings. Habitat selection by birds appeared to be related to the vegetational physiognomy rather than the floral composition of the habitat.

Introduction

Sagebrush (*Artemisia* spp.) was once the dominant vegetation over 60-100 million ha of the western rangelands in the United States (Beetle, 1960; Sturges, 1973). In historic times, the primary use of sagebrush range has been for livestock grazing. Efforts to improve the quality of rangelands for livestock traditionally involved the chemical or mechanical control of sagebrush followed by planting grass species such as crested wheatgrass (*Agropyron cristatum* and *A. desertorum*). In this century, 10-12 percent of the sagebrush-dominated rangelands were thusly altered (Vale, 1974). Research evaluating management practices on historic sagebrush range has focused mainly on the nutritive value and carrying capacity for livestock (Cook and Harris, 1952; Cook and Stoddart, 1953; Frischknecht *et al.*, 1953; Noll, 1955; McWilliams and Van Cleave, 1960; Pearson, 1965; Laycock, 1967; Frischknecht and Harris, 1968; McKendrick and Sharp, 1971), or on the effects of livestock grazing and sagebrush control on big game species (Anderson, 1969; Mackie, 1970; Peterson, 1971) and Sage Grouse (*Centrocercus urophasianus*) (Patterson, 1952; Klebenow, 1970; Martin, 1970). These studies indicate that while sagebrush conversion projects generally improve the native habitat for livestock use, large scale sagebrush control projects and/or competition with livestock adversely affect populations of deer (*Odocoileus hemionus*), wapiti (*Cervus elaphus*), pronghorn (*Antilocapra americana*), and Sage Grouse during some seasons.

With the exception of Sage Grouse, few studies have been published on the response of avifauna to sagebrush management and/or grazing pressures (Feist, 1968; Walcheck, 1970; Best, 1972; Schroeder and Sturges, 1975). This study compared the species diversity and relative density of nesting and non-nesting birds in four

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areas of different land management on the Idaho National Engineering Laboratory (INEL) Site in southeastern Idaho.

Study Areas

The INEL Site occupies 2315 km² of the upper Snake River Plain approximately 48 km west of Idaho Falls, Idaho. The Site is a National Environmental Research Park dominated by big sagebrush (*A. tridentata*) (Horniss and West, 1973). Parts of the park have been planted with crested wheatgrass, and livestock grazing is permitted on about 60 percent of the area (Fig. 1). Two of the four study areas were dominated by sagebrush, and two were former sagebrush range reseeded with crested wheatgrass. One sagebrush and one crested wheatgrass area were located just within the southern boundary of the INEL Site (Fig. 1). Crested wheatgrass was planted here in 1958 or 1959 (INEL Site records vary) after the native vegetation was removed by disking. These two areas were contiguous and were grazed by 1000-1200 domestic sheep each spring since 1960. These areas are referred to as GRAZED SAGE and GRAZED CWG.

The other study areas were approximately 12 km northwest of the GRAZED sites (Fig. 1). The sagebrush here (UNGRAZED SAGE) was grazed periodically prior to 1950. This area, with 25 years to recover from any grazing impacts, served as the control plot for the study. The adjacent crested wheatgrass planting (UNGRAZED CWG) was seeded in 1960 after winter flooding inundated and killed the native vegetation (A. Olson, pers. comm.). Domestic livestock were never pastured in this planting.

Both SAGE study areas and the GRAZED CWG occupied over 100 km². The UNGRAZED CWG was the largest tract of its kind we found on the INEL Site, but was less than 1 km².

Methods and Materials

The plant species composition and canopy coverage were estimated in each area along 4-100 m transect lines. Sampling frames, 20 x 50 cm (Daubenmire, 1959), were placed at 2.5 m intervals along each transect. Six cover classes (0-5 percent, 6-25 percent, 26-50 percent, 51-75 percent, 76-95 percent, 96-100 percent) were used to estimate the percent canopy coverage for each species. The average canopy coverage for each species was used to calculate the percent similarity (PS) (Orloci, 1967) among the study areas with the formula:

$$PS = 100 \left\{ 1 - \left[\frac{\sum_{i=1}^s \left(\frac{X_{i,B}}{\left(\sum_{i=1}^s X_{i,B}^2 \right)^{1/2}} - \frac{X_{i,A}}{\left(\sum_{i=1}^s X_{i,A}^2 \right)^{1/2}} \right)^2 \right]^{1/2} \right\}$$

where X was the average coverage value for each individual species(s) from the areas being compared (A and B).

Nesting bird species were examined using the singing male technique (Williamson, 1964) and the flushed male mapping procedure (Wiens, 1973). A 4-ha grid

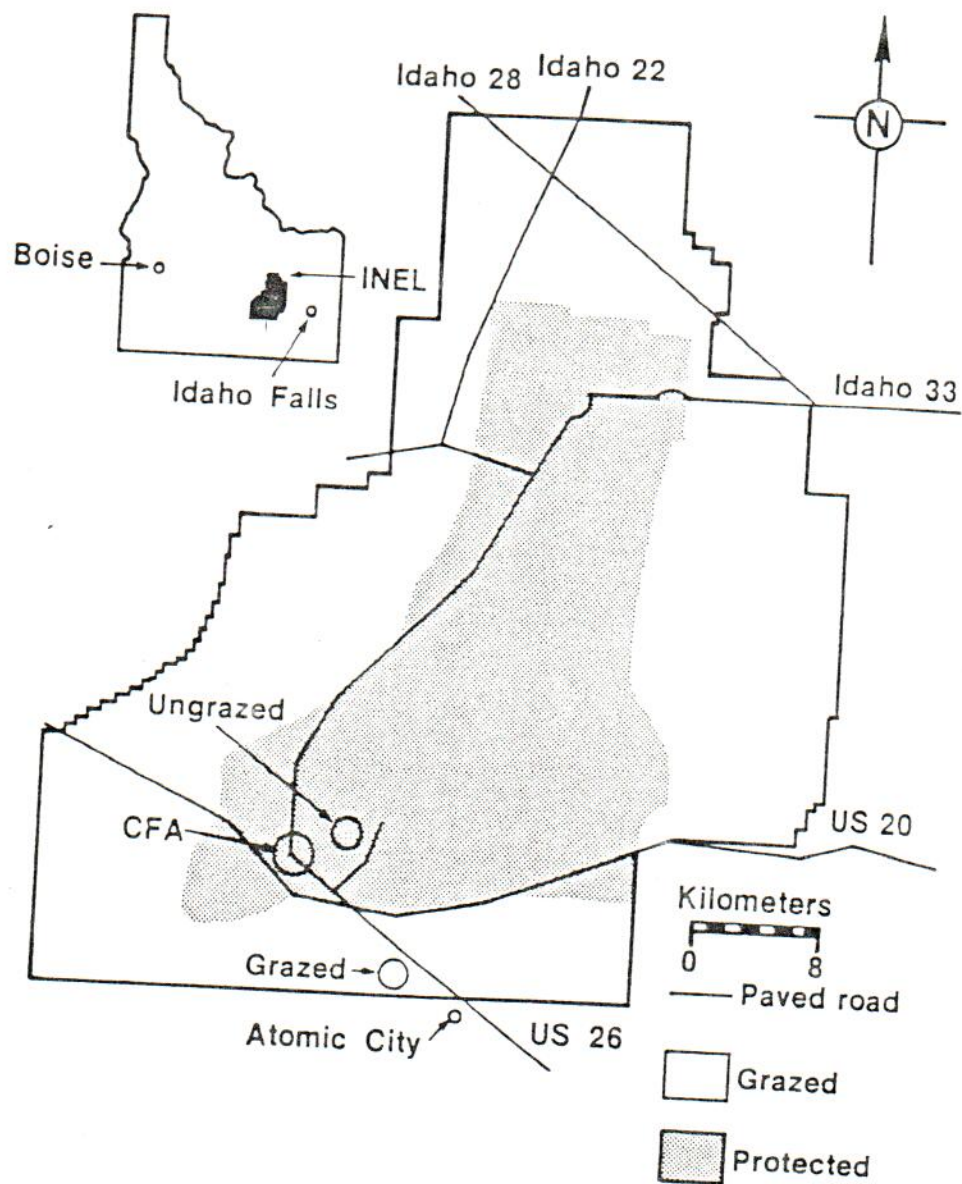


Figure 1. Grazed and ungrazed study areas on the INEL Site. Each area included a habitat dominated by big sagebrush and one dominated by crested wheatgrass. The portions of the INEL Site protected from livestock use are shown.

was established in each study area with 1.8-m tall wood stakes placed at 50-m intervals. The grid pattern in the two GRAZED study areas was a square 200 m on a side. The limited amount of area in the UNGRAZED CWG, and the unusual configuration of the adjacent UNGRAZED SAGE, prohibited establishing square grids in these areas (Fig. 2). All grid stakes were color-coded with plastic flagging to enhance accurate mapping of territories and location of nests.

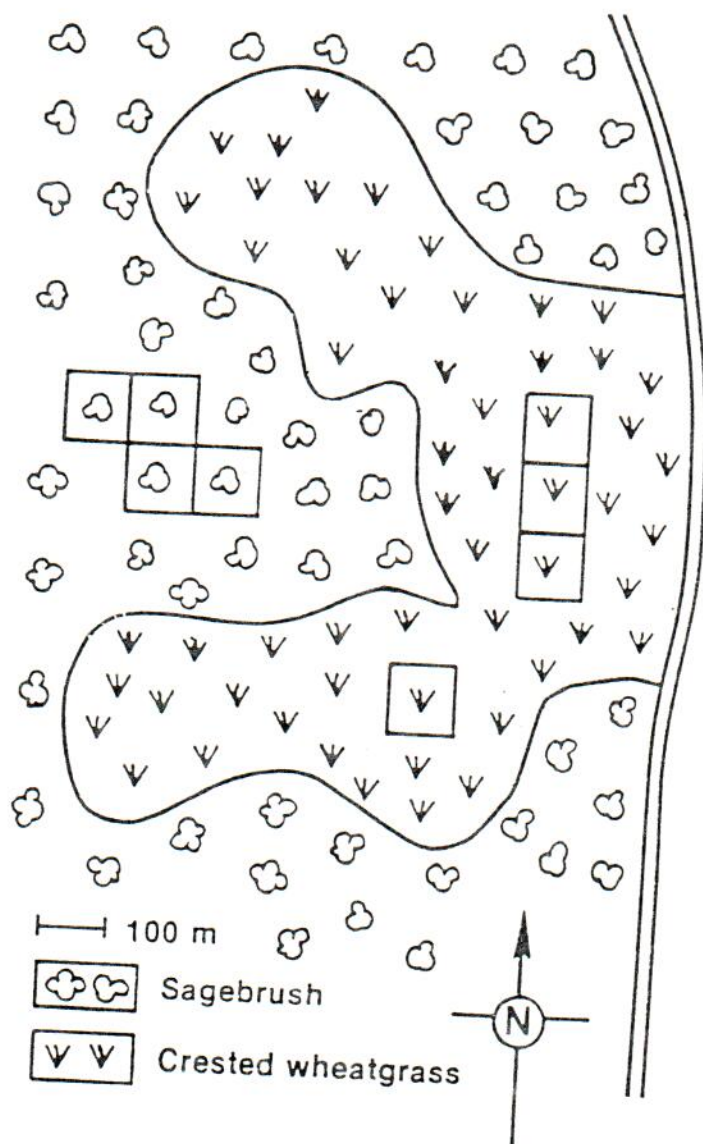


Figure 2. The configuration of the 4-ha UNGRAZED SAGE and UNGRAZED CWG. A paved road is at the extreme right.

Two researchers visited the study plots every other day during the 1976 and 1977 nesting seasons (mid-March through mid-July). One would examine both GRAZED areas while the other spent equal time in the UNGRAZED plots, alternating sites each visit. Investigation usually began 0.5 hr before sunrise and continued until the birds ceased singing, which was generally 4-6 hrs after sunrise. Additionally, evening visits were made on an irregular basis during the breeding season, and fortnightly examinations were conducted at various times of the day during the non-nesting season. Territory maps were made for each territorial bird (Reynolds and Rich, 1978), and

all nests were located by flushing a bird from its nest or by observing nest building, courtship, or food carrying behavior and then rigorously searching the area for the nest. The number and species of non-nesting birds (migrants and those nesting elsewhere on the Snake River Plain) encountered in each habitat were recorded as the relative density of these species in each study area. Differences in relative density were compared using the chi square statistic (Snedecor and Cochran, 1967).

A species diversity index (H) was calculated for nesting and non-nesting birds and for vegetation using a transformation of the Shannon equation (Zar, 1974):

$$H = (N \ln N - \sum f_i \ln f_i) / N$$

where f was the number (frequency) of each species i and N was the total frequency of all species. Differences in species diversity were tested with the t -test (Hutcheson, 1970). For all statistical tests, the level of significance was $P < 0.05$.

Results

Vegetation

Big sagebrush was the dominant vegetation in both SAGE study areas, providing 65 percent of the total canopy coverage in the GRAZED SAGE and 41 percent in the UNGRAZED SAGE. The control area contained the greatest number of plant species (31) (Table 1) and had a species diversity index of 2.85: significantly greater than all other areas. The percent similarity (PS) of the floristic composition of the two SAGE areas was 38 percent.

Crested wheatgrass was the primary component of the GRAZED and UNGRAZED CWG habitats, providing 89 and 98 percent of the total cover respectively. The PS value for the two CWG areas was 90 percent.

Nesting Birds

Seventy-one nests, representing 10 species, were located and monitored during the study (Table 2). There were no significant intra-area differences in the diversity or density of nesting birds between 1976 and 1977, which allowed us to pool the data over the 2-year period. The control area contained 27 nests representing 7 species, and had a species diversity index (H) of 1.67. Seven species accounted for 30 nests ($H = 1.40$) in the GRAZED SAGE. The density and species diversity of nesting birds in the two SAGE areas were not statistically different (Table 2).

Ten nests representing four species were located in the UNGRAZED CWG, but only four nests of one species (Horned Lark, *Eremophila alpestris*) were found in the GRAZED CWG. The species diversity indices were 1.19 and 0.00 respectively. Nesting density and species diversity differed significantly between the two CWG areas. Additionally, both CWG areas had a nesting density and species diversity significantly below the control (Table 2).

During the period when Horned Larks nests were found in the UNGRAZED CWG in 1976 (8-14 May), sheep were pastured in the grazed study areas. We found no evidence of Horned Larks nesting activities in the GRAZED areas until 28 May, nearly two weeks after the sheep had been moved to a different range. In 1977, the sheep were moved two weeks earlier (1 May) as a result of deteriorating range conditions resulting from regional drought. The first Horned Lark nest found in the

TABLE 1. Frequency (f), canopy coverage (%), and species diversity of vegetation in grazed and ungrazed habitats dominated by sagebrush or by crested wheatgrass on the INEL Site.^a

	UNGRAZED				GRAZED			
	SAGEBRUSH		CRESTED WHEAT-GRASS		SAGEBRUSH		CRESTED WHEAT-GRASS	
	%	f	%	f	%	f	%	f
<i>Crypantha watsoni</i>	0.2	5						
<i>Lappula redowskii</i>	0.1	5						
<i>Opuntia polyacantha</i>	1.2	13						
<i>Chenopodium leptophyllum</i>	0.6	17						
<i>Halogeton glomeratus</i>								
<i>Artemisia tridentata</i>	17.00	105			1.4	43	3.9	13
<i>Aster</i> sp. #1	+	1			25.0	113	0.5	5
<i>Aster</i> sp. #2	+	1						
<i>Aster scopulorum</i>	0.7	23						1
<i>Chaenactis douglasii</i>	0.3	4						
<i>Chrysothamnus nauseosus</i>	0.2	3						
<i>Erigeron pumilus</i>	0.3	11			1.6	15	0.4	5
<i>Lygodesmia grandiflora</i>	+	1						
<i>Arabis sparsiflora</i>	0.3	11	1.0	15				
<i>Descurainia sophia</i>	+	1						
<i>Lepidium pertoliatum</i>								
<i>Schoenocrambe linifolia</i>	0.1	7			0.2	2		
<i>Sisymbrium altissimum</i>	+	1						
<i>Stanleya viridiflora</i>	+	1						
<i>Menziesia glabella</i>	+	1						
<i>Agropyron cristatum</i>	1.9	15	52.0	160			39.4	154
<i>Agropyron spicatum</i>	6.0	35						
<i>Bromus tectorum</i>	0.7	8						
<i>Oryzopsis hymenoides</i>	5.2	34	0.2	3				
<i>Poa sandbergii</i>	1.8	16						
<i>Sitanion hystrix</i>	3.0	25			9.2	93		
<i>Astragalus purshii</i>	1.9	16						
<i>Allium geyeri</i>	+	1						
<i>Sphaeralcea munroana</i>	+	1						
<i>Eriastrum sparsiflorum</i>	+	3						
<i>Gilia leptomeria</i>	+	3						
<i>Phlox hoodii</i>								
<i>Eriogonum cernuum</i>	+	1			1.4	14		
<i>Cordylanthus ramosus</i>	+	1						
Total number of species	31		3		9		5	
Total percent of coverage	41.6		52.2		38.7		44.1	
Species diversity (H)	2.35a		0.57b		1.17c		0.54d	

^aSpecies diversities followed by a different letter are different ($P < 0.05$).

^bPercent coverage less than 0.1%.

GRAZED CWG that year was on 12 May, again almost two weeks after the sheep had been moved.

Non-nesting Birds

Thirty-six species of non-nesting birds were recorded in one or more of the study areas (Table 3). The species diversity indices followed the same pattern determined for nesting birds with $UNGRAZED\ SAGE = GRAZED\ SAGE > UNGRAZED\ CWG > GRAZED\ CWG$ (Table 3). Significantly fewer non-nesting birds were recorded in the two CWG areas than in the control area, but significantly more were found in the GRAZED SAGE than in any other area.

TABLE 2. Number of nests (relative density) and species diversity of nesting birds in grazed and ungrazed habitats dominated by sagebrush (*Artemisia tridentata*) or by crested wheatgrass (*Agropyron cristatum*) on the INEL site, 1976 and 1977.^a

SPECIES	UNGRAZED		GRAZED	
	SAGEBRUSH	CRESTED WHEAT-GRASS	SAGEBRUSH	CRESTED WHEAT-GRASS
Sage Grouse ^b <i>Centrocercus urophasianus</i>	0	0	1	0
Mourning Dove <i>Zenaidura macroura</i>	5	0	1	0
Short-eared Owl <i>Asio flammeus</i>	1	1	0	0
Loggerhead Shrike <i>Lanius ludovicianus</i>	1	0	1	0
Horned Lark <i>Eremophila alpestris</i>	0	4	1	4
Western Meadowlark <i>Sturnella neglecta</i>	1	4	0	0
Sage Thrasher ^b <i>Oreoscoptes montanus</i>	8	9	14	0
Vesper Sparrow <i>Pooecetes gramineus</i>	0	1	0	0
Sage Sparrow ^b <i>Amphispiza belli</i>	7	0	9	0
Brewer's Sparrow ^b <i>Spizella breweri</i>	4	0	2	0
RELATIVE DENSITY	27a	10b	30a	4b
SPECIES DIVERSITY	1.67a	1.19b	1.40a	0.90c

^aRelative densities and species diversity indices not followed by the same letter are different ($P < 0.05$).

^bSagebrush obligate (Braun et al. 1976).

TABLE 3. Number of observations (relative density) and species diversity of non-nesting birds in grazed and ungrazed habitats dominated by sagebrush or by crested wheatgrass on the INEL Site, March, 1976-August, 1977.^a

SPECIES	UNGRAZED		GRAZED	
	SAGEBRUSH	CRESTED WHEAT-GRASS	SAGEBRUSH	CRESTED WHEAT-GRASS
Red-tailed Hawk <i>Buteo jamaicensis</i>	2	2	1	1
Swainson's Hawk <i>Buteo swainsoni</i>	1	1	5	1
Rough-legged Hawk <i>Buteo lagopus</i>	2	1	1	0
Ferruginous Hawk <i>Buteo regalis</i>	2	1	1	0
Northern Harrier <i>Circus cyaneus</i>	12	10	18	10
Prairie Falcon <i>Falco mexicanus</i>	2	0	0	0
Kestrel <i>Falco sparverius</i>	1	1	4	2
Ring-necked Pheasant <i>Phasianus colchicus</i>	0	0	3	1
American Coot <i>Fulica americana</i>	1	0	0	0
Killdeer <i>Charadrius vociferus</i>	0	0	3	2
Long-billed Curlew <i>Numenius americanus</i>	1	1	0	1
Poorwill <i>Phalaenoptilus nuttallii</i>	0	0	1	0
Common Nighthawk <i>Chordeiles minor</i>	2	2	1	0
Common Flicker <i>Colaptes auratus</i>	1	1	2	0
Western Kingbird <i>Tyrannus verticalis</i>	0	1	2	0
Say's Phoebe <i>Sayornis saya</i>	0	0	1	0
Gray Flycatcher <i>Empidonax griseus</i>	1	0	0	0
Violet-green Swallow <i>Tachycineta thalassina</i>	0	0	1	0
Rough-winged Swallow <i>Stelgidopteryx ruficollis</i>	4	0	2	2
Barn Swallow <i>Hirundo rustica</i>	22	4	16	4
Cliff Swallow <i>Petrochelidon pyrrhonota</i>	0	1	4	2
Common Raven <i>Corvus corax</i>	1	1	17	5
Common Crow <i>Corvus brachyrhynchos</i>	1	0	0	0
Rock Wren <i>Salpinctes obsoletus</i>	0	0	1	0
American Robin <i>Turdus migratorius</i>	2	0	0	0
Yellow Warbler <i>Dendroica petechia</i>	0	0	1	0
Red-winged Blackbird <i>Aegialius phoeniceus</i>	0	2	0	0
Brewer's Blackbird <i>Euphagus cyanocephalus</i>	22	12	22	5

TABLE 3. (Continued)

Brown-headed Cowbird <i>Molothrus ater</i>	4	1	32	1
Pine Siskin <i>Spinus pinus</i>	0	0	2	0
American Goldfinch <i>Spinus tristis</i>	4	0	0	0
Lark Bunting <i>Calamospiza melanocorys</i>	1	0	0	0
Savannah Sparrow <i>Passerculus sandwichensis</i>	0	0	0	2
Chipping Sparrow <i>Spizella passerina</i>	0	0	1	0
White-crowned Sparrow <i>Zonotrichia leucophrys</i>	1	1	3	0
Snow Bunting <i>Plectrophenax nivalis</i>	6	18	16	24
RELATIVE DENSITY	96a	61b	161c	63b
SPECIES DIVERSITY (H)	2.47a	2.00b	2.61a	2.11c

*Relative densities and species diversity indices followed by a different letter are different ($P < 0.05$).

Discussion and Conclusions

The response of avian populations to different land management practices in historic sagebrush rangeland has received little attention in the literature. Sage grouse, Sage Thrashers (*Oreoscoptes montanus*), Brewer's Sparrows (*Spizella breweri*), and Sage Sparrows (*Amphispiza belli*) are considered sagebrush obligates, dependent on the sagebrush environment for nesting habitat (Braun *et al.*, 1976). Our data bear out this hypothesis. No nests of these species were located outside of the habitats dominated by sagebrush. Sagebrush obligates accounted for 70 percent of the nests in the control area and 90 percent of the nests in the GRAZED SAGE. Although the data are not conclusive, apparently those species not restricted to the sagebrush habitat may be more sensitive to the effects of grazing than sagebrush obligates. Alternatively, these non-obligate species may be demonstrating their ability to utilize different habitats when under stress, an adaptive advantage not shared by sagebrush obligates.

Mourning Doves (*Zenaida macroura*) are ubiquitous game birds in Idaho, nesting in trees, bushes, and on the ground (Larrison *et al.*, 1967). In this study, all dove nests were on the ground and placed under the crown of sagebrush plants. One hundred sixty observations of doves were recorded in the sagebrush habitats and 65 in CWG habitats, indicating that doves prefer sagebrush to crested wheatgrass plantings and may require brushy habitat for nesting activities in certain areas of the west.

The plant species diversity was reduced in the habitat dominated by sagebrush and grazed by sheep. This diversity was not accompanied by a reduction in the density or the diversity of either nesting or non-nesting birds. Crested wheatgrass plantings also exhibited a significant reduction in plant species diversity concomitant with significant reductions in both the diversity and density of nesting birds. Thus, the general pattern of habitat use by nesting species appears to be related to the basic physiognomy of the vegetation, with those species nesting in sagebrush habitats rarely if ever nesting in crested wheatgrass plantings, and vice versa. This pattern also seems to be true for the number of non-nesting birds: more migrants and birds nesting off the study areas used the habitats dominated by sagebrush than used crested wheatgrass plantings.

The diversity and density of nesting birds was further reduced in the area planted with crested wheatgrass and grazed by sheep, indicating a synergistic effect. Also, grazing appeared to result in a physical disturbance delaying the onset of nesting activities by Horned Larks.

In conclusion, spring grazing by domestic sheep appears to be compatible with

nesting and non-nesting bird populations in sagebrush-dominated habitats. However, planting a former sagebrush range with crested wheatgrass dramatically alters the structure of the plant community, rendering the habitat unsuitable for a diverse and abundant avifauna.

Acknowledgments

We gratefully acknowledge the field assistance provided by M. P. Mahoney, M. B. Reynolds, and D. P. Shorey in locating nests. J. F. Dupree donated his time and talents in plant collection and identification. We thank Drs. J. E. Anderson, E. Fichter, O. D. Markham, and C. E. Brown for critical review and evaluation of the manuscript. This work was supported in its entirety by the Division of Biomedical and Environmental Research of the U.S. Department of Energy.

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