Effects of Cattle Grazing on Passerine Birds Nesting in Riparian Habitat

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Abstract

Nine transects, in areas with different histories of cattle grazing, were established along the Blitzen River in Oregon. Counts of birds and measurements of vegetation were made in the summers of 1981 and 1982. Increased frequency of grazing on an annual basis correlated significantly with decreases in bird abundance, shrub volume, and shrub heights. The longer the time since a transect was last grazed correlated significantly with increases in bird abundance, shrub volume, and shrub heights. Bird abundance increased significantly with increased shrub volume and taller shrub heights. Bird species richness decreased with increased grazing. Bird counts were 5 to 7 times higher on an area ungrazed since 1940 than on 2 areas grazed annually until 1980, and 11 to 13 times higher than on a transect severely disturbed by extensive grazing and dredging activities. Disturbances from camper activities also appeared to reduce bird populations.

Riparian habitat is characterized by the presence of vegetation that requires free or unbound water, or conditions more moist than normal (Franklin and Dyrness 1973). It occupies a small percentage of land in western North America, but is disproportionately important to wildlife in general, and birds in particular (Pase and Layer 1977, Thomas et al. 1979, Szaro 1980). In arid areas of southern Arizona, southern New Mexico, and west Texas, of 166 breeding bird species studied, 77% were partially dependent and 51% completely dependent on this habitat (Johnson et al. 1977). Carothers and Johnson (1975) recorded 1,059 pairs of breeding birds on a 40.5-hectare plot in tall riparian cottonwoods (*Populus* sp.) in Arizona, which is the highest known density of noncolonial birds in North America (Davis 1977).

Because of the importance of riparian habitats to both bird population densities and species diversity, factors influencing these habitats and the bird communities they support need to be understood and proper management practices implemented to ensure their protection. The main objectives of this study were to determine effects of cattle grazing and associated disturbances on populations of passerine birds nesting in willow riparian habitat. The influences of dredging and camper activities were studied to a lesser extent.

Study Areas and Methods

Malheur National Wildlife Refuge (MNWR) covers 73,200 hectares in Harney County, southeast Oregon. The north end of the refuge encompasses Malheur Lake, a marsh of about 60,000 acres. The rest of MNWR consists primarily of numerous fenced and irrigated wet meadows and fields. There are shrubby stringers of willow (*Salix exigua* and other spp.) along various waterways including the Blitzen River, which historically was straightened and diked for the 50 km it runs through the refuge. MNWR lies at the northern edge of the Great Basin Province. Weather is characterized by cold winters, moderate summers, and low precipitation. In Burns, Oregon, 97 km north, the July average temperature is 19° C, the average January temperature is -3° C, and annual precipitation is 30 cm (Ferguson and Ferguson 1978).

In the late 1930's the number of cattle on MNWR was low, averaging around 40,000 Animal Unit Months (AUMs) annually. AUMs were increased on the refuge beginning with World War II, and by 1951 had reached 101,000. Heavy cattle use continued and averaged 118,000 AUMs annually over a 9-year period beginning in 1964. Cattle grazing, or to a lesser extent haying, occurred on virtually every hectare available during this period (Management Briefing Statement, MNWR, unpub. report 1976). Refuge personnel also removed some willows with herbicides and by manual cutting to increase the amount of grass available for cattle (Steve Thompson, MNWR, 1981, pers. comm.). After a peak of 126,000 AUMs in 1973, cattle use began declining steadily and had dropped to 31,515 AUMs by 1982 (MNWR, 1982, unpub. data). Many fields were placed in rest-rotation grazing systems, were hayed only, or were left undisturbed.

From late May to early July in 1981 and 1982 I collected data from 9 areas along the Blitzen River near the south end of MNWR. The elevation ranged from 1,280 to 1,300 meters. The grazing histories of these areas are given in Table 1.

Table 1. Histories of nine transects on the Blitzen River in Oregon.

Area	Transect Length (m)	History
1	1550	Extensive annual cattle use through 1974/75. Winter grazed in 1976/77, 80/81, and 81/82. Hayed only in 1977. Dredging activities in 1978 and 1979.
2	1550	Extensive annual cattle use through 1977/78. Winter grazed in 1981/82.
3	1150	Extensive cattle use through 1974/75. In non-use since except for 1979/80 season beginning 15 July.
4	1550	Extensive annual cattle use through 1974/75. In non-use since except for winter grazing in 1976/1977.
5	1550	Fenced and undisturbed since 1940.
6	585	Extensive cattle use until 1970, then fenced off. Part of an active campground.
7	585	Extensive cattle use until 1970, then fenced off.
8	585	Extensive cattle use until 1980, then fenced off.
9	585	Extensive cattle use until 1980, then fenced off.

Transects were established by laying a 50-meter tape parallel to the river 10 meters from the bank and marking the transect with numbered, colored flagging at 50-meter intervals. Vegetation data were gathered by first putting a 50-meter tape along an interval. As I moved along the tape, the vegetation category encountered was recorded on a data sheet where one square on the sheet equaled one meter along the tape. Vegetation categories were no vegetation,

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The author wishes to thank Charles Trost, Karl Holte, Don Brown, Mark Reynolds, Barry Noon, Olli Jarvinen, Jared Verner, and an anonymous reviewer for helpful suggestions. The staff of Malheur National Wildlife Refuge are thanked for their cooperation. Sherry Jacobs helped in the preparation of the tables.

Research was funded in part by the nongame program of the Oregon Department of Fish and Wildlife, and particularly Cal Giesler.

Manuscript accepted 29 August 1985.

herb-thistle, willow, and other types of shrubs and trees. Every shrub or tree within 37 meters of the river was measured for its length, width, and height. This allowed me to break vegetation into height classes, and also to estimate shrub volume. Because areas varied in length, these measurements were calibrated to 100 meters.

I counted all passerines (with exceptions listed below) along the transects using a Strip Survey Method (Mikol 1980). I recorded all male birds observed within 37 meters of the river's shoreline on the side I was walking. I walked slowly along the transect, pausing frequently to listen and look for birds. It took between 45 minutes and an hour and a half to count the 1,150 to 1,550-meter strips. Data recorded for each bird included distance from river; whether heard, seen, or both; behavior; location on transect; and comments. I walked the transects from just before sunrise to mid-morning, so a maximum of 2 areas were done in a day. Areas were counted on a rotating basis, about 4 days apart, 3 times each summer (but 1 area only twice in 1981). Birds flying above the canopy were not recorded unless in territorial flight display.

One is unlikely to detect every territorial male using a strip survey, so counts underestimate actual populations (Mikol 1980). In 1981 I ran 2 survey counts through an open field with patchy willows on MNWR. I then spot-mapped birds in the same area, and found the survey counts had underestimated the passerine community by 15 to 20%. This was in habitat similar to the river areas, but I felt it was harder to count because of its nonlinear characteristics. Chances of significant deviations from the actual number of territorial males were reduced by doing all the counts myself, by spending two weeks each year becoming familiar with the bird community, and practicing distance estimates prior to actual counts.

Comparisons between vegetation and grazing histories of areas were made with Pearson correlation coefficient tests (Zar 1974). I did not attempt to use actual density estimates of the passerine community in my analysis. Instead I ranked the relative abundances of passerines for each count (n=26 in 1981, n=27 in 1982, unless otherwise indicated). Spearman's rank correlation tests (Zar 1974) were used to compare abundances of birds with grazing histories or vegetation parameters. Because areas varied in length, numbers were expressed per 100 meters.

Accurate counts of swallows could not be obtained so they were not included in this study. I decided before starting not to include brown-headed cowbirds in estimates of the passerine community because of their nomadic behavior over part of their geographic range (Mahoney 1977), though recent evidence indicates they have more or less well-defined but very large breeding territories (Rothstein et al. 1984). Yellow-headed blackbirds were excluded from the bird estimates because of their colonial habits and specialized requirement for emergent vegetation. They made up a very small fraction of the bird community on these transects.

Results

Area 5, undisturbed for 4 decades, had 10 times as much shrub volume as the four most heavily grazed areas, one of which was also disturbed by dredging (Table 2). Shrub volume had a significant negative correlation with frequency of grazing both years (r=.79, P<0.02 in 1981; r=.76, P<0.02 in 1982, n=9 both years). The time since a transect was last grazed was positively and significantly correlated with shrub volume (r=.87, P<0.01 in 1981; r=.97, P<0.001 in 1982, n=9 both years). The amount of tall shrubs were also much higher on Area 5 and rarely disturbed areas such as 4 and 7 (Table 2).

Table 2. Height and volume of willow (*Salix* spp.) per 100 meters for nine areas along the Blitzen River, Oregon, in 1982.

	Height							Volume
	1m	2m	3m	4m	5m	6m	7m	m³
1	5.1	2.4	1.6	1.5	0.6	0.3		62.1
2	18.3	11.5	9.5	5.8	1.2			220.2
3	10.5	21.2	18.6	11.9	5.6	2.9	0.2	547.6
4	27.5	23.0	13.6	17.1	12.3	4.4	4.6	1037.6
5	10.1	23.1	23.6	20.4	13.4	10.7	15.1	2550.3
6	26.0	20.3	9.2	7.4	2.1			384.3
7	27.0	23.4	11.6	9.6	4.3	3.9	1.9	956.6
8	33.2	4.6	0.7					146.0
9	36.4	13.7	3.1	1.7				239.7

In both years 18 passerine species and 4 nonpasserine species were recorded holding territories on 1 or more of the transects (Table 3). The 5 terrestrial nonpasserines were not used in the population estimates and were a small percentage of the bird community. Undisturbed Area 5 had about 11 to 13 times as many birds in 1982 and 1981 respectively as Area 1, which was heavily disturbed by extensive grazing and dredging activities and had the least amount of vegetation (Table 2). Area 5 also had 5 to 7 times as many birds as Areas 8 and 9, which were heavily grazed until 1980. Area 4 had the second highest number of birds, and was grazed only once since 1975 (winter 1976/77), but Area 5 still had 94% more birds in 1981 and 53% more in 1982.

The relative abundance of passerines (Table 4) increased significantly with shrub volume (r_s=81, P<0.001 both years). The relative abundances of passerines were significantly and positively correlated with shrub heights 2 through 6 m both years (P<0.01, r_s= .56 to .87), but there was no significant correlation with 1-m high shrubs either year (P>0.05, r_s=.02, 1981; -.14, 1982).

In both years the relative abundances of breeding passerines were negatively correlated with frequency of grazing for the 7 areas without additional documented disturbances (n=20, r_s=-.89, P<0.01 in 1981; r_s=-.74, P<0.001 in 1982). Areas 1 and 6 were excluded because of dredging and camping activities respectively, but when all 9 areas were compared regardless of other disturbances, there was still a significant negative correlation (r_s=-.49, P<0.02 in 1981; r_s=-.51, P<0.02 in 1982).

The time since a transect was last grazed was significantly and positively correlated with the number of passerines for the 7 transects without additional documented disturbances (n=20, r_s=.96, P<0.001 in 1981; n=21, r_s.68, P<0.01 in 1982), and for all 9 transects regardless of additional disturbances (r_s=.70, P<0.001 in 1981, r_s=.55, P<0.01 in 1982).

Species richness on the four 1,550 m long areas showed an inverse relationship between frequency of grazing and number of breeding species (Fig. 1). There is a direct relationship between

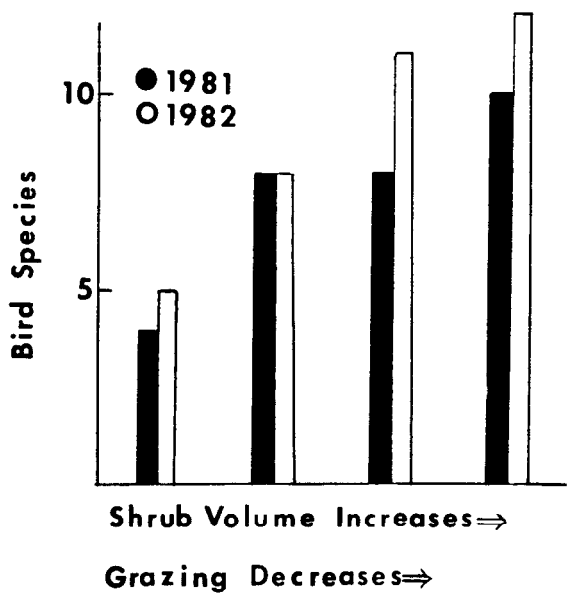

Fig. 1. *Number of species of birds found on 4 areas with 1,550-m transects along the Blitzen River, Oregon. Shrub heights and volume increase (see Table 2) and grazing and other disturbances decrease (see Table 1) as number of species increase.*

Table 3. Mean number of male birds on nine areas along the Blitzen River, Oregon.

		Area									
		1	2	3	4	5	6	7	8	9	Total
Nonpasserines											
Killdeer	1981	1.7			1.0						2.7
(Charadrius vociferus)	1982	1.7			1.0						2.7
Spotted Sandpiper	1981						2.0	1.0	3.7	1.5	8.2
(Actitis macularia)	1982	0.7			1.3		1.0	1.0	1.7	1.7	7.4
Mourning Dove	1981				1.5				0.3		1.8
(Zenaida macroura)	1982				1.3						1.3
Great Horned Owl	1981				1.3			0.8			2.1
(Bubo virginianus)	1982					2.0		0.3			2.3
Passerines											
Willow Flycatcher	1981		4.0	1.3	12.3	18.0					35.6
(Empidonax traillii)	1982		3.7	0.7	10.3	14.3					29.0
Eastern Kingbird	1981				1.0	0.7					1.7
(Tyrannus tyrannus)	1982				3.0	0.7					3.7
House Wren	1981										
(Troglodytes aedon)	1982							0.7			0.7
Marsh Wren	1981		0.7								0.7
(Cistothorus palustris)	1982		0.3	0.7							1.0
American Robin	1981	0.3		0.3	0.3			0.3	0.3	1.0	2.5
(Turdus migratoris)	1982	0.3		1.0	2.3	2.3	0.3	1.0	1.0		8.2
Cedar Waxwing	1981							0.7	0.7		1.4
(Bombycilla cedrorum)	1982										
Yellow Warbler	1981		4.7	3.0	10.0	23.7	2.0	5.3	0.7	1.0	50.4
(Dendroica petechia)	1982	0.7	5.3	3.7	13.7	18.3	0.3	2.3		0.7	45.0
Common Yellowthroat	1981	0.3	3.7			6.7					10.7
(Geothlypis trichas)	1982		1.3	0.3	0.7	4.0					6.3
Yellow-breasted Chat	1981									0.5	0.5
(Icteria virens)	1982										
Black-headed Grosbeak	1981				0.3	0.3					0.6
(Pheucticus melanocephalus)											
Savannah Sparrow	1981		0.3			0.7					1.0
(Passerculus sandwichensis)					0.3	1.0					1.3
Song Sparrow	1981	1.7	5.3	1.7	6.2	12.3	0.3	2.3		1.5	31.3
(Melospiza melodia)	1982	0.3	3.7	2.0	9.0	14.3	0.7	1.7		0.3	32.0
Bobolink	1981					1.3					1.3
(Dolichonyx oryzivorus)	1982						0.3				0.3
Red-winged Blackbird	1981	4.0	14.7	9.7	11.8	22.7	2.0	4.3	3.7	1.5	74.4
(Agelaius phoeniceus)	1982	4.0	6.7	10.3	6.7	14.7	2.3	1.7	1.0	1.7	49.1
Western Meadowlark	1981										
(Sturnella neglecta)	1982						0.3				0.3
Yellow-headed Blackbird	1981				(1.3)						(1.3)
(Xanocephalus xanocephalus)				(2.0)							(2.0)
Brewer's Blackbird	1981							0.7	2.0	1.0	3.7
(Euphagus cyanocephalus)		0.7	1.0					1.7	1.0	1.7	5.1
Brown-headed Cowbird	1981		(2.7)	(0.7)	(7.0)	(5.3)	(0.3)	(2.3)			(18.3)
(Molothrus ater)	1982		(3.3)	(1.7)	(4.7)	(6.7)				(1.0)	(17.4)
Northern Oriole	1981				0.7	0.3	0.3	0.7			2.0
(Icterus galbula)	1982				2.0			0.3			2.3
Cassin's Finch	1981						0.3				0.3
(Carpodacus cassinii)	1982										
American Goldfinch	1981						0.8	0.3	0.7		1.8
(Carduelis tristis)	1982					0.3					0.3
Passerine Sub-total	1981										219.2[a]
	1982										185.5[a]
Total	1981										253.6
	1982										218.6

[a]Totals do not include Brown-headed Cowbird or Yellow-headed Blackbird, which are shown in paraentheses.

shrub volume and species richness on these 4 transects. Undisturbed Area 5 had about 2.5 times as many species as the heavily disturbed Area 1.

Because of the unequalness of time spent on areas, these data could be biased towards having more birds on areas counted longer (J. Verner, pers. comm.). However, there was no correlation in 1982 between the amount of time spent in an area per 100 m of transect (n=23, Areas 1, 2, 7, and 9 each had 1 count where time was unrecorded) and abundance of birds (r_s=–0.06, P>.50).

Area 6 had a low relative abundance of birds compared to amount of vegetation. It had almost twice the shrub volume as Areas 2, 8, and 9 (Table 2) but fewer or equal numbers of birds (Table 4). This could be accounted for by the large numbers of campers using this area. I observed over 200 people in this campground in late May both years of the study, and they probably disturbed birds by their extensive use of river banks.

Table 4. Relative abundances of breeding passerines per 100 meters for each of three counts on nine areas along the Blitzen River, Oregon.

Area	Year	Count 1	Count 2	Count 3	Mean	SE
1	1981	.58	.39	.26	.41	.09
	1982	.47	.47	.33	.42	.04
2	1981	2.06	2.06	2.19	2.10	.04
	1982	.97	1.53	1.87	1.46	.25
3	1981	1.64	1.55	1.55	1.58	.03
	1982	1.80	1.89	1.71	1.80	.05
4	1981	3.74	2.32	2.45	2.84	.45
	1982	2.67	3.27	3.33	3.09	.21
5	1981	5.68	6.00	4.90	5.53	.33
	1982	4.47	4.67	5.00	4.71	.15
6	1981	1.03	1.20	.68	.96	.15
	1982	.35	1.06	.70	.70	.21
7	1981	3.08	3.42	2.39	2.96	.30
	1982	1.57	1.24	1.77	1.53	.15
8	1981	1.37	1.55	.68	1.20	.26
	1982	.71	.53	.53	.59	.06
9	1981	1.54	.68	—	1.11	.43
	1982	.35	.53	1.24	.71	.27

The only individual bird species which may have benefited from disturbance of willows by grazing and dredging was the killdeer, which was found in modest numbers on 2 of the most disturbed sites (Table 3). Bird species which were more abundant or limited to undisturbed or rarely grazed areas included great horned owl, eastern kingbird, willow flycatcher, yellow warbler, red-winged blackbird, brown-headed cowbird, and northern oriole (Table 3).

Discussion

Habitat structure is generally important to birds (Balda 1975, Meents et al. 1981) and bird abundance and species richness should be influenced by changes in vegetation structure. Area 5 data show that undisturbed willow riparian areas with tall and voluminous shrubs support large populations and more species of birds. Data from 8 other areas show bird populations and species richness increased with shrub heights and greater volume. Birds and shrubs both decreased with grazing. These results compare favorably with Duff (1979), who found that after 4 years raptors and passerines increased by 350% within an enclosure versus adjacent grazed areas. This large increase was associated with the reestablishment of a middle story of willow. Although effects of cattle grazing on willows in my study were based on grazing histories and not long-term observation, several studies have reported adverse effects of cattle grazing on riparian willows and other shrubs, or that willows recover when grazing is modified, reduced, or eliminated (Ames 1977, Winegar 1977, Duff 1979, Knopf and Cannon 1981, Rickard and Cushing 1982).

Fewest birds were found in Area 1, which was disturbed by extensive grazing and dredging activities, and had little tall vegetation. Similar results were found in a study along the Sacramento River, California, by Hurst et al. (1980), who found that unaltered riparian habitat supported about 7 times as many birds as rip-rap areas devoid of woody vegetation. Their data show that elimination of riparian vegetation, whether by excessive grazing or other factors, has a decidedly negative impact on the associated bird community.

Bird species use different strata of vegetation, and these strata have different vulnerabilities to grazing. The lower strata can be affected by short-term grazing (Ames 1977, Duff 1979). The shrub strata and most of its associated bird species can be adversely affected by cattle grazing, while the upper canopy and its birds are not (Mosconi and Hutto 1981). However, cattle grazing in riparian zones over several decades can eliminate or reduce the upper canopy by preventing the establishment of saplings (Glinski 1977).

A photograph of the Blitzen River near the southern border of MNWR taken in the early 1930's showed a tall deciduous upper canopy along the river (MNWR files). This woodland no longer exists. Protection from grazing would be important in efforts to reestablish this canopy and such an effort would enhance the riparian bird community. Residual clumps of trees along the river were searched and 12 species of birds were found that were either absent from or rare in the shrub community (Taylor 1984).

Grazing studies of various habitats such as aspen *(Populus tremuloides)* (Page et al. 1978), shortgrass prairie (Ryder 1980), fescue prairie (Owens and Myers 1973), and cottonwood riparian (Mosconi and Hutto 1981) have found some bird species benefit from grazing but others do not. Land managers should avoid grazing regimes which adversely influence particular species which are sensitive or endangered. Two birds found in this study to be much more abundant in rarely grazed or completely undisturbed willow areas were willow flycatcher and yellow warbler, both on the National Audubon Society's Blue List for species thought to be declining over a significant proportion of their range (Tate and Tate 1982).

It has been estimated that 70–90% of all natural riparian habitat within the U.S. has already undergone extensive alteration (Hirsch and Segelquist 1978). Livestock grazing is possibly the major cause of habitat disturbance in most western riparian communities (Mosconi and Hutto 1981). There is a wide variety of riparian communities in the West. Brown et al. (1979) have developed a tentative list of riparian associations for just the southwestern U.S. that includes 9 major plant groupings and 54 specific plant associations. For most of these associations, grazing regimes or other factors such as dredging which significantly reduce shrubs and/or the upper tree canopy will have a negative impact on the bird community in general and many bird species in particular. While some damaged riparian areas have been too severely disturbed or invaded by exotic plants to be restored, others should recover their original vegetation and associated bird communities given protection and time.

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DEADLINE DATES

Items such as columns, advertisements, announcements, lists, and reports must be in the Denver office by the following dates to ensure publication in the respective issues of *RANGELANDS:*

April—**March 3**
June—**May 3**
August—**July 5**
October—**September 5**
December—**November 1**
February—**December 7**

Position announcements must be in the Denver office by the following dates to be published in the respective issues of the *JOURNAL OF RANGE MANAGEMENT:*

March—**February 1**
May—**April 4**
July—**June 2**
September—**August 4**
November—**October 5**
January—**December 1**

Publications will normally be mailed by the 11th of the month of publication. Allow at least 2 weeks for delivery in the US.