

Bird Communities of Four Grazed and Ungrazed Habitats in the Post Oak Region of Texas

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Abstract: This study examined species composition and relative abundance of birds in the Post Oak Region of Texas during winter and spring 1993. A grazed and an ungrazed site were established in each of 4 habitat types: forests, woodlands, upland pastures, and wet meadows. Habitat characteristics of the study sites were evaluated using plot and point methods. Birds were surveyed using time-area circular plot methods with 4 plots per study site. Highest numbers of bird species and individuals were recorded in the woodlands during winter and wet meadows during spring. As a result of flocking birds, more individuals were recorded in grazed woodlands, pastures, and meadows than on the ungrazed sites during winter. Otherwise, ungrazed study sites generally had more species and individuals than did the grazed sites of similar habitats. Differences between grazed and ungrazed sites were probably the result of mechanical vegetation manipulation rather than cattle grazing.

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The Post Oak Region extends from the central portion of eastern Texas into southern Oklahoma. In Texas, it is a 3.4 million-ha strip that is more than 600 km long but only 96 km wide at its widest point. The region, an ecotone between the Pineywoods and Blackland Prairie regions, comprises almost 5% of the state (Gould 1975).

Numerous studies have examined bird-habitat relationships in the southeastern United States (Dickson et al. 1995). In the Pineywoods of eastern Texas, several studies have indicated that early successional habitats are heavily utilized by flocking winter visitors. As vegetation in such habitats ages, complexity of the avian community increases, but density may decrease. Before crown closure, such habitats are important to nesting migrants. After crown closure, both numbers of species and individuals decline, but then increase when overstory trees die and understory and midstory vegetation develops (Whiting 1978, Dickson et al. 1980, Dickson et al.

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1984, Whiting and Fleet 1987). Similar changes in bird communities occur in oak-hickory habitats (Johnston and Odum 1956, Shugart and James 1973, Conner and Adkisson 1975, Thompson and Fritzell 1990, Thompson et al. 1992).

No studies have examined avian communities in the Post Oak Region of Texas and Oklahoma. Likewise, studies of the impacts of cattle grazing and related management on birds east of the Great Plains are rare (Kozicky and Fulbright 1991). The objectives of this study were to examine and compare species composition and relative abundance of winter and spring bird communities on grazed and ungrazed sites in closed-canopy hardwood forests, savannah-like hardwood woodlands, upland pastures, and wet meadows.

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Methods

Study Area

The study area had gently rolling topography and a continuum of habitat types, ranging from dense deciduous forests to open pastures. There was a preponderance of open, savannah-type woodlands in which the most common overstory species was post oak (*Quercus stellata*). In the Post Oak Region, precipitation ranges 89 to 114 cm per year (Gould 1975). Summer temperature average about 28 C, and winter temperatures average about 9 C (Nat. Fibers Info. Ctr. 1987).

Eight study sites were established, 2 in each of the 4 habitat types. Study sites were a minimum of 15 ha. Within each habitat, the 2 sites were as similar as possible, except 1 site had been in a long-term cattle grazing lease that ended when this study began. Grazing occurred during spring, summer, and fall. Vegetation on the open woodland, upland pasture, and wet meadow sites had been shredded with a tractor-operated rotary mower to enhance grazing conditions at least once a year.

Data Collection

At each site, 4 2.25-ha circular study plots were established. Plot radii were 84.6 m and plot centers were 200 to 300 m apart. Most habitat variables were sampled on 3 subplots associated with each circular plot. One habitat subplot was at the center of the plot and the other 2 were on opposite sides of plot center, approximately 60 m from it, and along the transect lines between it and the adjacent plots. Radius of each habitat subplot was 15 m.

On each plot, woody plants ≥ 2.5 cm diameter-at-breast-height (DBH) were recorded by species and diameter. Snags were recorded, but by DBH only. Average

density, diameter, species richness, and basal area values were calculated for woody plants as were average density, diameter, and basal area for snags. Within each subplot, canopy closure of the midstory and overstory (i.e., overhead obscurity), understory cover type, and ground cover type were evaluated at 4 points using a sighting tube (Whiting and Fleet 1987). Understory cover types were recorded as (1) grass and sedge (2) herbaceous (3) woody, or (4) no foliage; ground cover types were (1) soil (2) litter (3) grass and sedge (4) herbaceous, or (5) woody. Using a density board, an index to foliage density (i.e., obscurity) in each subplot was evaluated in the 0–25, 26–50, 51–75, 76–100, 101–150, and 151–200 cm strata above ground level. These data were all pooled by plot and converted to percentages (Hedges 1998).

Birds were surveyed using time-area methods similar to those of Whiting and Baggett (1988). At the center of each study plot, a blind was constructed using vegetation and materials collected on the site. A bird survey consisted of the data collected during 1 day on 1 study site by 1 observer. Winter birds were surveyed on 4 days in February 1993, and spring birds were surveyed on 4 days in May 1993. The same 4 observers were used for all surveys and surveys were conducted only when all observers could work. Each observer surveyed 2 sites per day. The order that study sites were surveyed was reversed on subsequent mornings. Observers rotated study site pairs so that each observer surveyed every site during February and May. At least 2 surveys each season began approximately one-half hour before sunrise in an attempt to record nocturnal birds.

For each survey, an observer spent 15 minutes in a blind, recording the number and species of birds seen or heard. Birds heard but not seen were recorded as 1 individual. All birds observed on the plot during the 15-minute period were recorded.

The study area was relatively small (748 ha) and habitats on it were fragmented, thus the study plots were neither randomly located nor replicated. Therefore, the sampling design did not allow statistical tests; means and standard deviations were calculated for habitat and bird parameters, however. For birds, common names follow the American Ornithologists' Union checklist (1998) in which scientific names are included.

Results

Habitat Characteristics

Forests. These sites were heavily wooded with dense overstories and midstories. They ranked highest among all habitat types for density, species richness, and basal area of woody plants, density of snags, and midstory and overstory obscurity values. The forest sites ranked lowest among study sites, however, for horizontal foliage density values in strata between 0 and 100 cm, but the highest for such values in the strata between 100 and 200 cm and were the only habitat types to have higher values in the 101 to 200 cm strata than in the 0 to 100 cm strata (Table 1).

The grazed and ungrazed forest sites appeared to be most similar among the

Table 1. Characteristics of large woody plants, snags, and horizontal density on 4 grazed and 4 ungrazed study sites in the Post Oak Region of Texas during fall 1993; means and standard deviations are shown.

Habitat characteristic	Study site								
	Forest		Woodland		Pasture		Wet meadow		
	Grazed	Ungrazed	Grazed	Ungrazed	Grazed	Ungrazed	Grazed	Ungrazed	
Woody plants									
Density (stems/ha)	949.2± 87.6	993.0± 197.2	38.7± 38.6	239.0± 122.1	11.7± 20.3	234.2± 60.9	5.7± 11.5	102.2± 77.1	
Diameter (cm)	13.4± 10.3	11.6± 9.9	33.0± 24.4	17.4± 18.2	14.7± 6.1	6.2± 5.3	17.2± 15.5	23.6± 14.8	
N Species/2.25-ha plot	15.0± 1.6	11.5± 1.3	3.5± 2.5	8.2± 1.5	0.5± 0.6	7.0± 2.2	0.7± 1.5	4.2± 2.9	
Basal area (m ² /ha)	21.4± 1.5	18.5± 1.0	4.3± 2.5	11.1± 9.3	0.2± 0.3	1.3± 0.9	0.2± 0.5	6.2± 5.9	
Snags									
Density (stems/ha)	48.2± 2.5	38.5± 18.8	1.2± 2.5	13.0± 12.8	0.0	1.2± 2.5	0.0	3.5± 4.3	
Diameter (cm)	14.3± 7.2	18.2± 10.2	18.1± 0.0	23.8± 18.6	–	40.6± 0.0	–	32.1± 25.1	
Basal area (m ² /ha)	1.3± 0.1	0.9± 0.4	0.1± 0.1	0.5± 0.6	0.0	0.1± 0.3	0.0	0.1± 0.7	
Horizontal foliage density index values by strata above ground level									
0–25 cm	132.8± 31.6	292.0± 125.5	436.8± 41.7	220.8± 52.4	360.3± 113.4	881.5± 256.2	1279.5± 156.2	1014.8± 285.9	
26–50 cm	27.5± 15.8	90.5± 37.2	187.5± 55.2	87.8± 23.6	73.0± 23.7	285.0± 25.6	333.5± 93.1	316.5± 64.4	
51–75 cm	15.0± 12.8	32.2± 16.7	63.2± 13.8	58.8± 37.3	15.2± 8.0	97.8± 40.2	88.0± 47.0	150.0± 76.1	
76–100 cm	11.2± 9.1	22.2± 11.7	24.0± 11.8	41.0± 18.6	17.2± 24.0	65.2± 30.2	30.8± 36.0	64.8± 24.5	
101–150 cm	21.2± 13.4	42.0± 5.4	15.2± 10.0	38.2± 16.3	3.5± 2.1	51.0± 27.3	5.2± 9.8	15.2± 6.8	
151–200 cm	32.2± 8.4	50.2± 8.9	6.0± 6.3	38.5± 10.4	0.8± 0.5	34.0± 11.9	0.5± 1.0	4.8± 4.5	

Table 2. Characteristics of overhead obscurity, understory cover, and ground cover on 4 grazed and 4 ungrazed study sites in the Post Oak Region of Texas during fall 1993; means and standard deviations are shown.

Habitat characteristic	Study site							
	Forest		Woodland		Pasture		Wet meadow	
	Grazed	Ungrazed	Grazed	Ungrazed	Grazed	Ungrazed	Grazed	Ungrazed
Overhead obscurity (%)								
(>150 cm above ground level)								
Midstory	54.2±14.3	46.0± 8.0	0.0	12.5± 5.2	0.0	0.0	0.0	4.2± 8.5
Overstory	91.7± 6.9	79.0± 8.0	37.5±26.2	62.5±31.3	0.0	0.0	4.2± 8.5	27.0±18.5
Understory cover (%)								
(6–150 cm above ground level)								
Grass	0.0	2.0± 4.0	0.0	0.0	8.2±11.8	0.0	19.0±17.3	0.0
Herbs	0.0	0.0	27.2±22.9	2.0± 4.0	37.7±22.1	8.2± 6.9	2.0± 4.0	14.5±14.1
Woody	10.5±18.2	31.2± 8.1	12.7± 8.5	23.2±12.5	14.5±29.0	12.5±10.8	10.5± 8.2	0.0
None	89.5±18.2	66.7± 7.0	60.5±30.0	74.7±11.8	39.5±35.5	79.2±14.3	68.7±22.9	85.5±14.2
Ground cover (%)								
(0–5 cm above ground level)								
Soil	0.0	0.0	6.0± 4.0	10.2± 4.5	6.2±12.5	0.0	0.0	0.0
Litter	47.7±10.5	37.5±15.8	25.0±13.9	48.2±23.9	6.2± 8.1	2.0± 4.0	2.0± 4.0	6.0± 4.0
Grass	43.7±16.0	60.5±17.1	52.0±18.5	39.7±19.9	73.0±21.8	58.2± 7.0	66.7±28.4	68.7±18.7
Herbs	4.2± 8.5	0.0	14.5± 8.2	2.0± 4.0	14.5± 8.1	36.2± 6.5	29.2±25.8	18.7±10.4
Woody	4.2± 8.5	2.0± 4.0	2.0± 4.0	0.0	0.0	4.0± 4.6	2.0± 4.0	6.2±12.5

paired habitat sites. Differences in habitat characteristics were almost nonexistent. The only noticeable difference was grass in the understory; the grazed site had almost no grass, whereas the ungrazed site had a measurable amount (Table 2).

Woodlands. These sites had large, scattered trees in a savannah-type situation. The grazed site had higher horizontal foliage density values in the lower 3 profiles than did the ungrazed site; the relationship was reversed in the upper profiles (Table 1). Also, overhead obscuration values were much higher on the ungrazed than grazed woodland (Table 2). On the ungrazed site, there were more woody plant species and individuals and more basal area per ha than on the grazed site; snags were almost nonexistent on the grazed site (Table 1).

Upland Pastures. These sites were characterized by upland topographic positions and lack of large trees. The pastures had relatively low values associated with woody plants and relatively high values associated with understory and ground cover variables (Tables 1, 2). Several years prior to the study, the ungrazed site had been converted from a forest to a pasture. Most merchantable timber was removed, non-merchantable trees and brush were cut, row piled, and burned, and weeping lovegrass (*Eragrostis curvula*) was seeded over the area. However, the site had been neither grazed nor shredded since converted from a forest. The grazed site had been managed as a pasture for many years; it had been grazed and probably shredded annually.

Wet Meadows. Like the pastures, the wet meadow sites had relatively little woody vegetation. However, their topographic positions were lower and relatively level; both sites were adjacent to persistent beaver ponds and were partially flooded during each sampling period. The grazed meadow had been under a moderate-to-heavy grazing regime for numerous years and was regularly shredded; the ungrazed site had been subjected to occasional light grazing by cattle from adjacent lands when fences were in disrepair. Differences between the sites were evident in many habitat categories (Tables 1, 2).

Winter Birds

During winter surveys, 4,383 individuals of 58 bird species were recorded (Table 3). Due to the small sample sizes and flocking birds, variances in numbers of species and individuals per survey were great (Table 4). Brown-headed cowbirds and red-winged blackbirds comprised 65% of the individuals recorded. Large flocks of these species, which shared a communal roost on the study area, were recorded on the grazed pasture and the grazed woodland, which were adjacent. The northern cardinal was the third most abundant species and was recorded on all 8 study sites. The American robin was the only other species recorded on every study site (Table 3). Good winter habitat for a wide variety of seed-eating migrants was obviously available on the study area. Nine species of sparrows as well as American goldfinches and dark-eyed juncos were recorded, many in relatively high numbers (Table 3).

Fewer species and, if a single flock of red-winged blackbirds is excluded, fewer individuals were recorded on the forest sites than on any other site (Tables 3, 4). Although more species were recorded in the grazed than ungrazed forest (Table 3), average numbers of species per survey were identical (Table 4). More species

Table 3. Numbers of birds recorded on grazed and ungrazed habitats in the Post Oak Region of Texas, winter 1993. Residency status follows Fisher and Wolf (1979) (R = resident, W = winter resident, M = migrant, and SB = spring breeder). Common names follow the AOU checklist (1998) and are in order of ascending AOU number.

Common name	Residency	Study site								Total
		Forest		Woodland		Pasture		Wet meadow		
		Grzd	Ungrzd	Grzd	Ungrzd	Grzd	Ungrzd	Grzd	Ungrzd	
Double-crested cormorant	R	-	-	5	-	-	-	1	-	6
Mallard	W	-	-	-	-	-	-	2	-	2
Wood duck	R	-	-	4	-	-	-	16	9	29
Great blue heron	R	-	-	2	-	-	-	1	-	3
Common snipe	W	-	-	-	-	-	-	11	-	11
Killdeer	R	-	-	-	-	-	-	8	1	9
Mourning dove	R	-	-	1	1	83	2	3	1	91
Turkey vulture	R	-	-	-	-	-	-	2	3	5
Black vulture	R	-	-	-	-	2	-	-	-	2
Red-tailed hawk	R	-	-	3	-	-	-	-	-	3
Red-shouldered hawk	R	1	-	-	-	-	-	-	-	1
American kestrel	R	-	-	-	-	-	1	-	-	1
Belted kingfisher	R	-	-	-	3	-	-	6	1	10
Hairy woodpecker	R	3	1	3	-	-	1	-	1	9
Downy woodpecker	R	3	-	5	5	1	-	1	13	28
Yellow-bellied sapsucker	W	-	4	6	5	-	-	-	-	15
Pileated woodpecker	R	-	-	1	1	-	1	-	-	3
Red-headed woodpecker	R	-	-	-	1	-	-	-	2	3
Red-bellied woodpecker	R	4	-	1	1	1	-	2	5	14
Northern flicker	R	1	-	2	6	-	1	2	1	13
Eastern phoebe	R	-	1	1	-	1	1	3	3	10
Blue jay	R	3	-	1	6	1	6	7	6	30
American crow	R	1	4	3	17	2	-	10	7	44
Brown-headed cowbird	R	-	-	202	-	184	-	17	-	403
Red-winged blackbird	R	-	211	1,046	10	974	1	216	5	2,463
Eastern meadowlark	R	-	-	-	-	-	12	1	-	13
Common grackle	R	-	-	43	-	4	-	-	-	47
American goldfinch	W	-	-	1	6	-	-	-	1	8
Grasshopper sparrow	R	-	-	-	-	-	-	-	1	1
White-crowned sparrow	W	-	-	2	-	-	-	-	-	2
White-throated sparrow	W	-	-	48	26	2	63	-	8	147
Chipping sparrow	R	-	-	40	11	7	3	-	-	61
Clay-colored sparrow	W	-	-	-	-	2	-	-	-	2
Field sparrow	R	-	-	-	36	-	8	-	-	44
Dark-eyed junco	W	-	-	62	4	7	4	-	-	77
Song sparrow	W	-	-	14	-	2	12	2	13	43
Swamp sparrow	W	-	-	-	-	-	-	-	2	2
Fox sparrow	W	-	-	-	1	-	-	-	-	1
Northern cardinal	R	17	35	64	28	11	52	2	17	226
Cedar waxwing	W	7	10	5	7	-	4	2	-	35
Loggerhead shrike	R	-	-	-	-	-	-	1	1	2
Blue-headed vireo	W	-	-	1	-	-	-	-	-	1
Yellow-rumped warbler	W	-	7	4	1	-	-	-	6	18
Northern mockingbird	R	1	-	-	-	1	15	4	4	25
Brown thrasher	R	-	-	-	1	-	-	-	-	1
Carolina wren	R	8	2	6	6	1	-	-	1	24
Brown creeper	W	-	-	-	3	-	-	-	-	3
White-breasted nuthatch	R	1	-	3	3	-	-	-	-	7
Red-breasted nuthatch	W	-	-	1	-	-	-	-	-	1
Brown-headed nuthatch	R	-	-	-	1	-	-	-	-	1

Table 3 (continued)

Common name	Residency	Study site								Total
		Forest		Woodland		Pasture		Wet meadow		
		Grzd	Ungrzd	Grzd	Ungrzd	Grzd	Ungrzd	Grzd	Ungrzd	
Tufted titmouse	R	31	20	19	31	9	1	-	9	120
Carolina chickadee	R	23	47	29	36	4	5	-	10	154
Golden-crowned kinglet	W	1	-	2	-	-	-	-	-	3
Ruby-crowned kinglet	W	9	12	4	8	1	2	-	2	38
Blue-gray gnatcatcher	SB	-	-	2	-	-	-	-	-	2
Hermit thrush	W	1	-	-	1	-	-	-	-	2
American robin	R	9	5	1	1	3	4	9	4	36
Eastern bluebird	R	-	-	5	-	3	-	5	15	28
<i>N</i> species		18	13	37	30	23	21	25	29	58
<i>N</i> individuals		124	359	1,642	267	1,306	199	334	152	4,383

were recorded on each woodland site than on any other site and more individuals were recorded on the grazed woodland than on any other site (Table 3). Five of the 10 most abundant species had their highest occurrences on the grazed woodland (Table 3). Brown-headed cowbirds and red-winged blackbirds, the 2 most abundant species on the grazed woodland, were represented by only 10 individuals on the ungrazed site. Dark-eyed juncos and cardinals were also more numerous on the grazed woodland than on the ungrazed woodland (Table 3).

Numbers of species recorded on the grazed and ungrazed pastures were similar and were lower than numbers on the woodlands but higher than numbers on the forest sites. The number of individuals on the grazed pasture was the second-highest recorded, due to flocking brown-headed cowbirds, red-winged blackbirds, and mourning doves (Table 3). Total numbers of species recorded on the grazed and ungrazed wet meadows were higher than on the pastures but lower than on the woodlands. The average number of species per survey was higher on the ungrazed wet meadow than on the ungrazed woodland (Table 4). The wet meadows were the only habitat in which more species were recorded on the ungrazed site than on the grazed site (Table 3). As with the woodlands and pastures, more individuals were recorded on the grazed meadow than on the ungrazed site. However, almost 65% of the birds recorded on the grazed meadow were red-winged blackbirds. More wetland-associated individuals also were recorded on the grazed than on the ungrazed wet meadow. The grazed wet meadow was definitely attractive to both the common snipe and the killdeer.

Spring Birds

During the spring, 1,134 individuals of 57 species were recorded (Table 5). The reduction in the total number of individuals from winter to spring can be attributed to fewer flocking birds. Twenty-four species were spring breeders, 3 were winterers, and 1 was a migrant; the remainder were residents (Table 5). The northern cardinal was the most common species and was regularly recorded on each study site. Other species recorded on every study site were Carolina wrens and tufted titmice. The study area apparently provided nesting habitat for numerous species of neotropical

Table 4. Average numbers of bird species and individuals recorded per survey on 4 grazed and 4 ungrazed study sites in the Post Oak Region of Texas during winter and spring 1993; standard deviations are also shown.

	Study site							
	Forest		Woodland		Pasture		Wet meadow	
	Grazed	Ungrazed	Grazed	Ungrazed	Grazed	Ungrazed	Grazed	Ungrazed
Winter								
Species	8.0 ± 2.2	8.0 ± 1.8	16.5 ± 4.1	14.0 ± 3.7	8.7 ± 5.0	9.7 ± 3.2	11.0 ± 1.4	14.5 ± 3.3
Individuals	31.0 ± 15.2	89.7 ± 102.9	410.5 ± 144.2	66.7 ± 29.8	326.7 ± 289.6	49.7 ± 23.1	83.5 ± 98.3	38.0 ± 9.7
Spring								
Species	7.5 ± 2.3	7.2 ± 1.5	10.5 ± 1.7	12.0 ± 3.3	8.5 ± 1.7	12.0 ± 3.3	13.2 ± 1.7	16.2 ± 2.7
Individuals	22.5 ± 9.9	24.5 ± 9.9	38.0 ± 10.6	29.7 ± 4.9	20.0 ± 5.4	60.5 ± 17.0	38.7 ± 7.5	48.5 ± 12.7

Table 5. Numbers of birds recorded on grazed and ungrazed habitats in the Post Oak Region of Texas during spring 1993. Residency status follows Fisher and Wolf (1979) (R = resident, W = winterer, M = migrant, and SB = spring breeder). Common names follow the AOU checklist (1998) and are in order of ascending AOU number.

Common name	Residency	Study site								Total
		Forest		Woodland		Pasture		Wet meadow		
		Grzd	Ungrzd	Grzd	Ungrzd	Grzd	Ungrzd	Grzd	Ungrzd	
Double-crested cormorant	R	-	-	-	-	1	-	2	-	3
Wood duck	R	-	-	2	-	-	-	12	3	17
Great blue heron	R	-	-	-	-	-	-	2	-	2
Great egret	R	-	-	-	-	-	-	1	2	3
Cattle egret	R	-	10	-	-	4	-	14	23	51
Killdeer	R	-	-	-	-	-	-	3	-	3
Mourning dove	R	-	1	1	1	4	1	1	6	15
Turkey vulture	R	-	-	1	1	-	1	1	3	7
Black vulture	R	-	-	-	-	-	-	-	2	2
Red-shouldered hawk	R	1	-	-	-	-	-	-	-	1
Yellow-billed cuckoo	SB	-	-	-	1	-	2	-	-	3
Belted kingfisher	R	-	-	-	1	-	-	1	-	2
Hairy woodpecker	R	-	-	-	1	-	1	-	-	2
Downy woodpecker	R	2	-	-	1	-	-	-	1	4
Pileated woodpecker	R	-	-	-	-	1	-	1	-	2
Red-bellied woodpecker	R	-	1	-	5	-	-	-	8	14
Northern flicker	R	-	-	-	1	-	-	-	-	1
Chimney swift	SB	-	-	-	-	-	2	-	-	2
Ruby-throated hummingbird	SB	-	-	-	-	-	1	-	-	1
Scissor-tailed flycatcher	SB	-	-	-	-	5	1	3	-	9
Eastern kingbird	SB	-	-	-	-	1	1	6	9	17
Great crested flycatcher	SB	-	-	-	-	2	2	3	5	12
Eastern wood-pewee	SB	1	-	7	5	1	3	-	4	21
Acadian flycatcher	SB	-	-	-	-	-	-	-	1	1
Blue jay	R	1	1	1	4	-	-	-	1	8
American crow	R	-	-	2	1	2	-	-	-	5
Brown-headed cowbird	R	-	1	5	1	4	11	4	7	33
Red-winged blackbird	R	-	-	-	-	9	2	19	10	40
Orchard oriole	SB	-	-	2	-	-	1	-	-	3
Baltimore oriole	M	-	-	-	-	-	1	-	1	2
Common grackle	R	-	-	-	-	-	-	4	4	8
American goldfinch	W	-	-	-	-	-	-	38	3	41
Northern cardinal	R	29	34	29	28	14	44	5	19	202
Indigo bunting	SB	-	1	1	1	4	16	1	22	46
Painted bunting	SB	-	-	2	-	1	19	-	-	22
Dickcissel	SB	-	-	-	-	-	1	1	-	2
Summer tanager	SB	5	1	21	8	8	10	-	5	58
Cliff swallow	SB	-	-	-	-	3	-	5	10	18
Barn swallow	SB	-	-	2	-	7	-	19	7	35
Cedar waxwing	W	-	-	28	2	5	99	-	11	145
Red-eyed vireo	SB	3	2	1	2	2	-	-	1	11
White-eyed vireo	R	3	22	1	-	-	2	1	2	31
Black-and-white warbler	SB	1	5	-	-	-	-	-	-	6
Northern parula	SB	-	3	-	1	-	-	-	2	6
Kentucky warbler	SB	-	-	-	2	-	-	-	-	2
Common yellowthroat	SB	-	-	-	-	-	1	-	-	1
Yellow-breasted chat	SB	-	-	-	-	-	1	-	-	1
Hooded warbler	SB	1	-	-	-	-	-	-	1	2
Northern mockingbird	R	-	-	-	-	-	4	1	1	6

Table 5 (continued)

Common name	Residency	Study site								Total
		Forest		Woodland		Pasture		Wet Meadow		
		Grzd	Ungrzd	Grzd	Ungrzd	Grzd	Ungrzd	Grzd	Ungrzd	
Carolina wren	R	20	5	5	20	-	3	1	3	57
House wren	W	3	-	-	-	-	-	-	-	3
White-breasted nuthatch	R	1	-	-	3	-	2	-	-	6
Tufted titmouse	R	17	3	11	20	-	2	3	6	62
Carolina chickadee	R	1	-	10	3	-	-	2	1	17
Blue-gray gnatcatcher	SB	3	8	20	6	2	8	-	10	57
Wood thrush	SB	2	-	-	-	-	-	-	-	2
American robin	R	-	-	-	-	-	-	1	-	1
<i>N</i> species		17	15	20	24	20	28	28	33	157
<i>N</i> individuals		94	98	152	119	80	242	155	194	1,134

migrants. Six species of warblers, 5 species of flycatchers, and 2 species each of buntings, swallows, and vireos were recorded on the study area; 7 wetland-associated species were also recorded. The wet meadows had the highest numbers of species and individuals and the forests had the lowest.

Of the 4 habitats, the forest sites were the most similar in both numbers of species and individuals. Average number of species per survey was slightly higher on the grazed forest than on the ungrazed forest; numbers of individuals showed the opposite trend (Table 4). For the woodlands, which demonstrated the opposite trends (Table 4), differences between sites were somewhat greater. Of the 24 species recorded on the ungrazed woodland, 7 were cavity nesters; only 2 cavity-nesting species were recorded on the grazed woodland (Table 5). The largest difference between study sites occurred on the pastures where more species and individuals were recorded on the ungrazed than on the grazed pasture (Table 5). In fact, during spring, more individuals were recorded on the ungrazed pasture and fewer on the grazed pasture than on any other study site (Table 5). As with the forests and woodlands, numbers of species and individuals were somewhat similar on the ungrazed and grazed wet meadows. Unlike the forests and woodlands, however, more species and individuals were recorded on the ungrazed than grazed meadow (Tables 4, 5).

Discussion

Forests. During winter, there was little evidence that grazing impacted the size of the forest bird community. However, livestock use did impact some species, with woodpeckers, Carolina wrens, tufted titmice, and American robins more abundant on the grazed than ungrazed forest (Table 3). These results were probably related to more woody plant species, somewhat more snags, less understory cover, and lower horizontal foliage density values on the grazed forest than on the ungrazed forest (Tables 1, 2). Butler (1979) found that woodpeckers, eastern wood-pewees, tufted titmice, American robins, and chipping sparrows, all either trunk-foragers, cavity-nesters, or ground-foragers, benefited from grazing in a mixed-oak forest in southwestern Pennsylvania.

During spring, there were even fewer differences between the grazed and ungrazed forest sites in species richness or abundance than during winter. The numbers of resident and spring breeding individuals were almost identical on the grazed and ungrazed forests. As with winter, Carolina wrens and tufted titmice were much more abundant on the grazed than ungrazed forest (Table 5); conversely, white-eyed vireos were much more abundant on the ungrazed forest. White-eyed vireos nest in low thickets and dense shrubs (Peterson 1963), and there was 3 times more woody cover in the understory of the ungrazed forest than in that of the grazed forest (Table 2). Overall, however, similarities in bird communities of the sites suggest that differences in vegetation or management practices had little impact on the bird community. Sedgwick and Knopf (1987) also found that birds in a ground-shrub resource-using guild differed little between grazed and ungrazed sites in a cottonwood bottomland in northeastern Colorado.

Woodlands. The woodland winter bird community was obviously affected by grazing, or more likely, the associated management (i.e., shredding). The grazed woodland had fewer but larger trees than did the ungrazed site (Table 1), resulting in less canopy cover and more herbs and grasses in the understory and groundcover (Table 2). Seeds from the grasses and herbs attracted many seed-eating birds, which were more numerous on the grazed site and represented by more species than on the ungrazed site (Table 3). In fact, the field sparrow was the only seed-eating species considerably more numerous on the ungrazed woodland than on the grazed woodland. The Carolina chickadee and tufted titmouse, which roost in cavities, were likewise more common on the ungrazed site (Table 3), which had many more snags than the grazed site (Table 1). However, the great disparity in the numbers of seed-eaters caused the substantial difference in numbers of individuals between the sites.

During spring, bird communities of the woodland sites were much more similar than during winter. However, more total individuals and more spring breeders were recorded on the grazed than ungrazed woodland (Table 5). In contrast, Dambach (1944) found more species and individuals on an ungrazed woodland than on a grazed woodland during the breeding season. In this study, higher numbers of summer tanagers and blue-gray gnatcatchers on the grazed woodland were probably related to the more open and developed canopy on that site than on the ungrazed woodland. Peterson (1963) stated that both species are open woodland dwellers. Conversely, the complete absence of woodpeckers in the grazed woodland (Table 5) was surely due to the lack of snags (Table 1).

Pastures. The winter bird communities on the pastures paralleled those of the woodlands, with more species and individuals recorded on the grazed than ungrazed pasture (Table 3). However, if brown-headed cowbirds, red-winged blackbirds, and mourning doves are excluded, less than 70 birds would have been recorded on the grazed pasture (Table 3). These 3 species were probably feeding on the abundant seeds of goatweed (*Croton* sp.) on the site. Baker and Guthery (1990) found more doves on heavily grazed sites in the Texas Coastal Bend than on moderately grazed sites and they attributed the differences to the abundance of goatweed on the heavily

grazed sites. Regardless, highly mobile, flocking species apparently found the grazed pasture more valuable than did other species.

During spring, many more species and individuals, including spring breeders, were recorded on the ungrazed pasture than on the grazed pasture (Table 5). The ungrazed pasture was more structurally diverse, with brush and scattered mature trees, and provided better foraging and nesting habitat for a wider variety of species and individuals than did the grazed site. Further evidence of superior nesting habitat on the ungrazed pasture may be the higher number of brown-headed cowbirds recorded there; the cowbirds were probably searching for nests of other species in which to lay their eggs. The ungrazed pasture probably was structurally similar to the seedling pine stands described by Whiting and Fleet (1987); those stands contained more species and individuals than did older mixed pine-hardwood stands.

Wet meadows. Very little information is available concerning winter bird communities in relation to grazing of wetland or riparian grasslands. Most studies concerning grazing in these types of habitats are from western North America and involve surveys during the breeding season (Medin and Clary 1990, Dobkin et al. 1998). In riparian habitats in Idaho, more shorebirds, including killdeer, were found on grazed sites than on ungrazed sites (Medin and Clary 1990). In this study, more standing water on the grazed than on the ungrazed wet meadow surely contributed to the higher numbers of common snipe, killdeer, and other wetland-associated species. Also, the closely cropped grass in and around the standing water probably provided excellent foraging habitat for snipe and killdeer. Higher numbers of canopy-dwelling and seed-eating species on the ungrazed than grazed wet meadow (Table 3) were likely due to more trees on the ungrazed site (Table 1).

In spring, more wetland-associated species on the grazed than on the ungrazed meadow can be attributed to the same factors as during winter. Grazing may have also contributed to an abundance of thistle on the grazed site and thus the numerous American goldfinches recorded there. However, management practices, including shredding, on the grazed meadow reduced nesting and foraging habitat for northern cardinals, Carolina wrens, indigo buntings, and other species. The interspersed large trees on the ungrazed meadow attracted canopy dwellers, such as blue-gray gnatcatchers, tufted titmice, and summer tanagers (Table 5). In contrast to this study, Medin and Clary (1990) recorded more bird species and individuals in grazed than in ungrazed riparian grassland habitats during spring. Similar to this study, however, Dobkin et al. (1998) recorded more bird species and individuals in ungrazed exclosures than on plots open to grazing in riparian meadow habitats in the northwestern Great Basin.

Management Implications

As many studies have shown, bird communities vary widely along a successional gradient. Generally, migrants are more common in early successional habitats and residents are more common in late successional habitats. This was supported by our study in the Post Oak Region. Bock et al. (1992) concluded that grazing was

neither wholly detrimental nor beneficial to wildlife and suggested that vegetative and animal communities of certain habitats tolerate or even rely on ecological disturbances resulting from livestock grazing and associated management. Resource managers must remember that grazing is a useful tool in habitat manipulation and should understand how different grazing practices impact the species composition of various habitats. Ideally, this study should increase that understanding in the Post Oak Region of Texas and Oklahoma.

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