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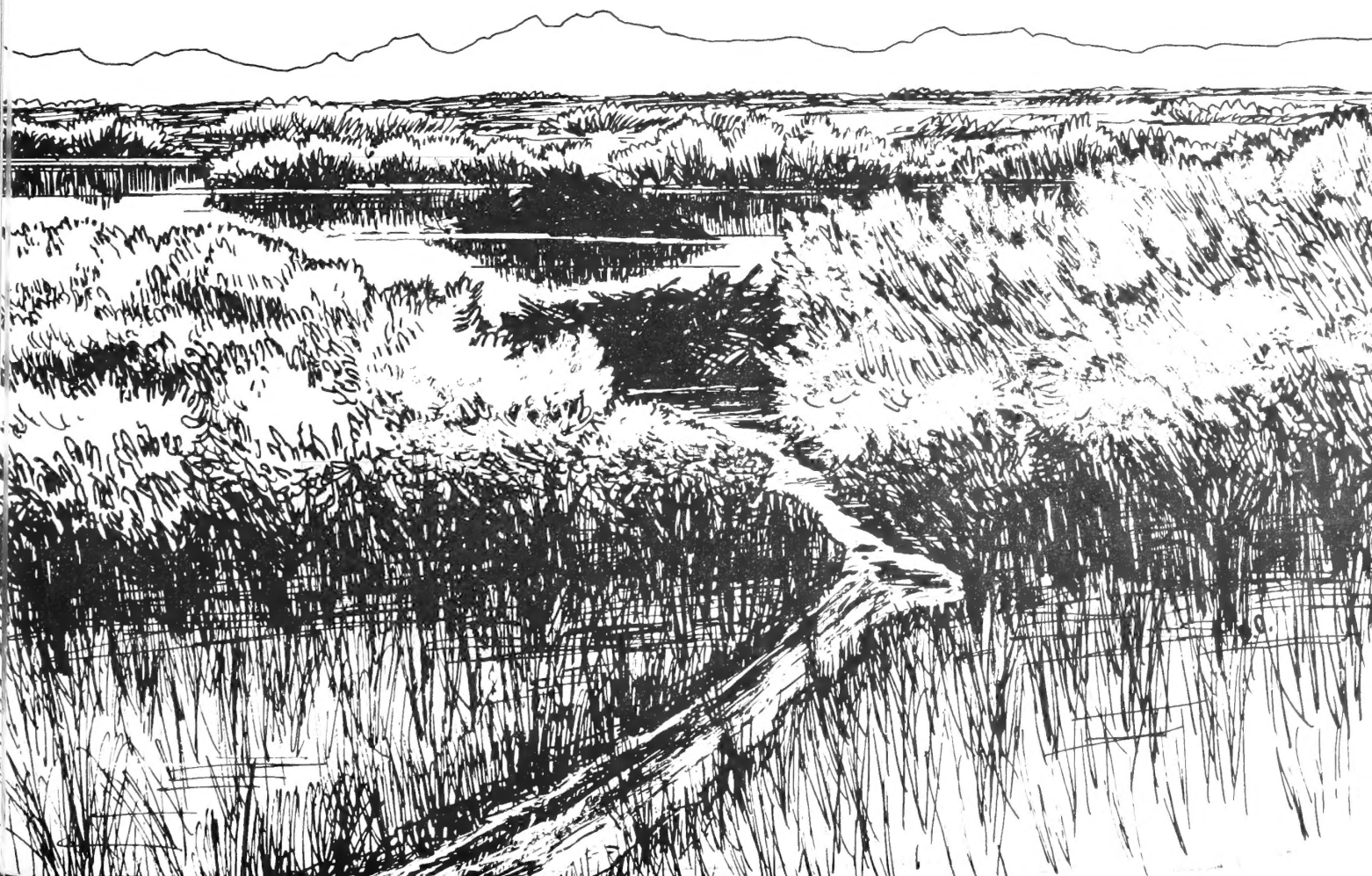
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# Bird Populations in and Adjacent to a Beaver Pond Ecosystem in Idaho

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## THE AUTHORS

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## RESEARCH SUMMARY

We compared breeding bird populations and community organization between a beaver pond habitat dominated by willows (*Salix* spp.) and an adjacent nonwillow riparian habitat on Summit Creek in east-central Idaho. For the previous 14 years both habitats had been protected from livestock grazing by a fenced enclosure (122-ha). Bird populations were determined by spot-mapping on 9-ha plots in spring 1989. Structural (physiognomic) differences in vegetation between the two habitats and the availability of impounded water on the beaver pond site were reflected in associated breeding bird populations. Total bird density in the beaver pond habitat was three times that of the adjacent riparian habitat. Similarly, our estimates of total bird biomass, bird species richness, and bird species diversity were 3.49, 3.25, and 1.67 times higher, respectively, in the beaver pond habitat. Further, there were more foraging and nesting guilds represented on the beaver pond plot than elsewhere. Our findings suggest that beaver pond ecosystems can provide important habitats for nongame breeding birds.

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## INTRODUCTION

Beavers (*Castor canadensis*) alter riparian-stream ecosystems through their woodcutting and dam-building activities. The resultant habitats can be beneficial to some forms of wildlife and detrimental to others (reviewed in Hill 1982; Jenkins and Busher 1979). But to date, little information is available on the importance of beaver pond habitats for nongame birds. This study compared breeding bird populations and bird community organization between a willow (*Salix* spp.)-dominated beaver pond habitat and an adjacent nonwillow riparian habitat on Summit Creek in east-central Idaho.

Beavers built both a primary dam and several secondary dams in a previously unoccupied section of Summit Creek in the summer and fall of 1979 (Lewis 1989). During the year of study (1989), about one-third hectare of surface water was impounded by the dams. Both the beaver pond complex and the adjacent site were protected from live-stock grazing for the previous 14 years by a large (122-ha) fenced enclosure. The enclosure, constructed in late 1975, is on public lands administered by the Bureau of Land Management, U.S. Department of the Interior.

## STUDY AREA

The study site was 41 km north of Mackay in eastern Custer County, ID. Elevation is about 1,975 m. Summit Creek, a tributary of the Little Lost River, originates from springs and flows through a broad, basinlike valley bounded on the east by the Lemhi Range and on the west by the Lost River Range. Regional climate is semiarid. Average annual precipitation at Mackay (elevation 1,797 m) is 247 mm, with peaks in May and June. The growing season is short, averaging less than 100 days at Mackay (USDC NOAA 1982). Microrelief in many parts of the riparian area is hummocky, with soils high in total salts (USDA SCS 1987). Except for the beaver pond complex, the riparian area was seldom more than 50 to 100 m wide.

Four major vegetation community types were defined on the study site. These were: willow/mesic herbaceous, sagebrush (*Artemisia* spp.)/upland, mat muhly (*Muhlenbergia richardsonis*)/hummock, and mesic herbaceous. The upland communities occupied the gentle slopes and terraces that bordered both the beaver pond complex and the nonponded area. The willow/mesic herbaceous community type was found only in the immediate vicinity of the beaver pond. The mat muhly/hummock, and mesic herbaceous communities were considered elements of the riparian zone and were found on both the willow and nonwillow study sites.

Upland vegetation was shrub-steppe. The most common shrubs were low sagebrush (*A. arbuscula*), threetip sagebrush (*A. tripartita*), and green rabbitbrush (*Chrysothamnus viscidiflorus*). The understory included Sandberg's bluegrass (*Poa sandbergii*), bluebunch wheatgrass (*Agropyron spicatum*), and long-leaf phlox (*Phlox longifolia*). The willow/mesic herbaceous community characterized the beaver pond complex. Geyer willow (*S. geyeriana*), bilberry willow (*S. myrtilifolia*), Bebb willow (*S. bebbiana*), and water birch (*Betula occidentalis*) formed the tall-shrub overstory. The understory included a wide variety of graminoids and forbs. The stream was closely bordered by clumped mesic herbaceous communities dominated by beaked sedge (*Carex rostrata*), water sedge (*C. aquatilis*), Baltic rush (*Juncus balticus*), and Kentucky bluegrass (*P. pratensis*). Hummocky areas, dominated by mat muhly and thick-spiked wheatgrass (*A. dasystachyum*), were generally located in an intermediate position between the streamside communities and the sagebrush uplands.

## METHODS

Two 9-ha plots, one in the upper (westernmost) section of the enclosure and the other in the beaver pond (downstream) area, were censused for breeding birds using the Williams' spot-map method (International Bird Census Committee 1970). Plot locations were selected to best represent both the

beaver pond (willow) habitat and the adjacent non-willow riparian habitat. Nearly half of the plot encompassing the beaver pond habitat was made up of willow/mesic herbaceous communities. The census plots, 600 by 150 m, were oriented lengthwise along Summit Creek and included both sides of the creek. Plots were surveyed and gridded with points flagged and marked with numbered stakes at 25-m intervals.

Eleven census visits were made to each plot from May 17 to June 29, 1989. Most of the bird registrations were recorded from sunrise to early afternoon when birds were most active. To ensure complete coverage, the plot was censused by walking within 25 m of all points on the grid. Census routes were varied. Recorded bird observations extended a minimum of 50 m beyond plot boundaries.

At the end of the sampling period, clusters of observations on species maps were circled to define breeding bird territories. Fractional parts of boundary territories were included in the results. The reciprocal of Simpson's index ( $D = 1/\sum p_i^2$ , where  $p_i$  is the proportion of the sample belonging to the  $i$ th species) was used to calculate species diversity (Hill 1973).

Vegetation and other features of the census plots were measured from July 17 to August 30, 1989. A 50- by 50-cm (0.25-m<sup>2</sup>) quadrat was located at each of 20 systematically positioned sample locations in each major vegetation community type on the study plots. Canopy cover (Daubenmire 1959) was ocularly estimated for the total of each plant life form (graminoid,

forb, shrub) and recorded as the midpoint of one of eight percentage cover classes (0-1, 1-5, 5-10, 10-25, 25-50, 50-75, 75-95, 95-100 percent). Percentages of litter, rock, bare ground, and lichen-moss were similarly estimated. The vegetative height (excluding flower and seed-head heights) of each graminoid, forb, and shrub nearest the center of each quadrat was recorded.

Biomass of graminoids, forbs, and small shrubs was determined by clipping vegetation from ground level upward within a vertical projection from the 0.25-m<sup>2</sup> quadrats. Clipped materials were bagged, oven-dried, and weighed. A 3- by 3-m (9-m<sup>2</sup>) plot, concentric to each 0.25-m<sup>2</sup> quadrat, was used to sample biomass of large shrubs. Basal diameter, maximum height, and species were recorded for each shrub stem rooted within the plot. For willow clumps, average stem diameter and average stem height were recorded instead of individual stems. Equations provided by Brown (1976) were used to estimate biomass of the large shrubs.

Plant names follow Hitchcock and Cronquist (1973). Bird nomenclature is from the 1983 AOU checklist (American Ornithologists' Union 1983).

## RESULTS AND DISCUSSION

Major structural (physiognomic) differences in the vegetation occurred between the beaver pond complex and the adjacent riparian habitat (table 1). The most

**Table 1**—Vegetation and other features of a beaver pond complex (willow) and adjacent (nonwillow) riparian habitat, Summit Creek, ID, 1989

Item	Beaver pond (willow)		Adjacent (nonwillow)		<i>P</i> <sup>3</sup>
	Mean <sup>1</sup>	SD	Mean <sup>2</sup>	SD	
Graminoid					
Biomass (g/m <sup>2</sup> )	342	220	268	254	0.07
Canopy cover (pct)	60.8	22.9	61.6	30.5	.86
Height (m)	.29	.15	.18	.09	<.01
Forb					
Biomass (g/m <sup>2</sup> )	23.7	29.3	24.9	29.8	.82
Canopy cover (pct)	12.0	13.1	12.0	13.2	.99
Height (m)	.08	.06	.07	.05	.58
Shrub					
Biomass (g/m <sup>2</sup> )	183	295	71.1	164	<.01
Canopy cover (pct)	12.3	20.7	7.4	14.5	.10
Height (m)	.64	.57	.34	.21	<.01
Other					
Bare ground (pct)	15.7	14.3	20.3	25.0	.21
Litter (pct)	13.0	12.3	10.4	11.5	.22
Rock (pct)	.46	1.42	.64	1.52	.48
Lichen-moss (pct)	.24	1.05	.30	1.15	.76

<sup>1</sup>*n* = 80 except for shrub height mean where *n* = 79.

<sup>2</sup>*n* = 60 except for forb and shrub height means where *n* = 58 and 52, respectively.

<sup>3</sup> Probability associated with unpaired *t*-tests. *P* of 0.10 or less was considered significant.

evident difference was in the overstory layer where shrub biomass, shrub canopy cover, and shrub height means were higher on the beaver pond site. Shrub height and shrub biomass values in the beaver pond habitat were about twice those of the nonponded area. Differences in the shrub component were predominantly due to the abundance of willows that were found throughout the beaver pond complex. Photographic evidence shows a pronounced enlargement of the willow stand since the construction of the beaver dams (Anderson 1989). Before dam construction, willows formed only a narrow band along the stream.

Differences between the two areas were also found in the herbaceous layer where graminoid biomass and graminoid height means were higher in the beaver pond habitat (table 1). The differences seemed to be mostly due to thicker and taller stands of grasses and sedges, predominantly beaked sedge, that grew on the moist sites near the beaver pond. Presumably, those responses were caused by a higher water table near the beaver impoundments. Forbs exhibited no differences in canopy cover, height, or biomass means between study plots.

We recorded 13 breeding bird species on the Summit Creek study plots (table 2). The most

**Table 2**—Density (number/ha), diversity, and other attributes of breeding bird populations in a beaver-pond complex (willow) and adjacent (nonwillow) riparian habitat, Summit Creek, ID, 1989

Species	Foraging guild <sup>1</sup>	Nesting guild <sup>2</sup>	Density	
			Beaver pond (willow)	Adjacent (nonwillow)
Killdeer ( <i>Charadrius vociferus</i> )	GGI	GRN	0.22	+ <sup>3</sup>
Spotted sandpiper ( <i>Actitis macularia</i> )	SGL	GRN	.22	0.00
Common snipe ( <i>Gallinago gallinago</i> )	GPV	GRN	.09	.00
Willow flycatcher ( <i>Empidonax traillii</i> )	ASI	BTN	1.04	.00
American robin ( <i>Turdus migratorius</i> )	GGV	BTN	.07	.00
Yellow warbler ( <i>Dendroica petechia</i> )	LGI	BTN	1.22	.00
Common yellowthroat ( <i>Geothlypis trichas</i> )	LGI	GBN	.09	.00
Vesper sparrow ( <i>Pooecetes gramineus</i> )	GFO	GRN	.11	.42
Savannah sparrow ( <i>Passerculus sandwichensis</i> )	GFO	GRN	2.16	1.96
Song sparrow ( <i>Melospiza melodia</i> )	LFO	GBN	.33	.00
Red-winged blackbird ( <i>Agelaius phoeniceus</i> )	GFO	CRN	.20	.60
Western meadowlark ( <i>Sturnella neglecta</i> )	GGI	GRN	.27	.40
Brewer's blackbird ( <i>Euphagus cyanocephalus</i> )	GFO	GBN	4.09	+
Total number/ha			10.11	3.38
Biomass (g/ha) <sup>4</sup>			422	121
Species richness ( <i>n</i> )			13	4
Species diversity <sup>5</sup> ( $1/\sum p_i^2$ )			4.21	2.52

<sup>1</sup> After DeGraaf and others (1985). GGI = ground gleaning insectivore, SGL = shoreline gleaning insectivore, GPV = ground probing vermivore, ASI = aerial-sally feeding insectivore, GGV = ground gleaning vermivore, LGI = lower-canopy gleaning insectivore, GFO = ground foraging omnivore, LFO = lower-canopy and ground foraging omnivore.

<sup>2</sup> After Harrison (1979). GRN = ground nester, BTN = bush and small tree nester, GBN = ground and bush nester, CRN = cattail, rush, sedge, reed, grass, and bush nester.

<sup>3</sup>+ indicates the bird was observed infrequently.

<sup>4</sup>Species weights from Dunning (1984).

<sup>5</sup>After Hill (1973). Here,  $p_i$  is the proportional abundance of the *i*th species in the sample.

common species were the savannah sparrow (*Passerulus sandwichensis*), Brewer's blackbird (*Euphagus cyanocephalus*), yellow warbler (*Dendroica petechia*), willow flycatcher (*Empidonax traillii*), and red-winged blackbird (*Agelaius phoeniceus*). Collectively, those five species accounted for over 80 percent of the breeding bird community. Other common species included the western meadowlark (*Sturnella neglecta*), vesper sparrow (*Poocetes gramineus*), and song sparrow (*Melospiza melodia*). Wide-ranging raptorial birds, although commonly seen, were not included in our analysis. Transient species were also excluded.

Breeding bird densities were markedly different on the two study plots (table 2). Total bird density in the beaver pond habitat (10.11 birds/ha) was three times that of the adjacent riparian habitat (3.38 birds/ha). Similarly, our estimate of total breeding bird biomass was appreciably higher (422 g/ha versus 121 g/ha) in the willow-dominated beaver pond complex. Further, bird species richness and bird species diversity values were 3.25 and 1.67 times higher, respectively, in the beaver pond habitat.

Total breeding bird density recorded in the beaver pond habitat at Summit Creek exceeds densities found in most North American rangeland habitats (Wiens and Dyer 1975) and compares favorably with those of coniferous forests throughout North America (Wiens 1978). But Johnson and others (1980) list breeding bird densities in riparian wetlands, especially cottonwood-willow habitats in the southwestern United States, that are substantially higher than those we found at Summit Creek.

There were important organizational differences between the two breeding bird communities of the beaver pond complex and the adjacent riparian habitat. Numerically, the dominant species on the beaver pond area were Brewer's blackbirds,

savannah sparrows, yellow warblers, and willow flycatchers (table 2). Those four species made up 84 percent of the breeding bird community in the beaver pond habitat. Shorebirds—killdeer (*Charadrius vociferus*), spotted sandpiper (*Actitis macularia*), and common snipe (*Gallinago gallinago*)—were present in low densities. They were found as breeding birds only near the beaver pond; none bred in the nonponded riparian habitat. The American robin (*Turdus migratorius*) and common yellowthroat (*Geothlypis trichas*) also bred only in the beaver pond habitat. Of the four species breeding in the nonwillow riparian habitat, all were included among the much larger number of species that bred in the beaver pond habitat. Only the savannah sparrow showed a clear pattern of numerical dominance within the nonwillow habitat.

Birds may be placed in categories, or guilds, based on similarities in their use of environmental resources (Root 1967). The breeding bird species listed in table 2 were organized into feeding and nesting guilds based on their foraging behavior and the substrates used for nesting (table 3). Birds that forage or probe for food on the ground formed the largest single category. That guild accounted for 66 percent of the breeding bird population in the beaver pond habitat and 88 percent in the nonwillow riparian habitat. These, along with the lower-canopy feeders, made up the largest fraction of all feeding guilds in the beaver pond habitat. Aerial-sally feeders were represented by a single species—the willow flycatcher. Only ground feeders were found in the nonwillow habitat.

Ground and ground-bush nesters occurred in similar densities in the beaver pond habitat (table 3). Numerically, those species accounted for 75 percent of the breeding bird population in the beaver pond habitat. Bush or small tree nesters were represented by the willow flycatcher, yellow warbler,

**Table 3**—Guild structure of breeding birds in a beaver pond complex (willow) and adjacent (nonwillow) riparian habitat, Summit Creek, ID, 1989

Guild	Beaver pond (willow)		Adjacent (nonwillow)	
	Number/ha	Percent	Number/ha	Percent
Foraging				
Ground-shoreline gleaning	0.78	8	0.40	12
Ground foraging-probing	6.65	66	2.98	88
Aerial-sally feeding	1.04	10	0	0
Lower canopy gleaning-foraging	1.64	16	0	0
Nesting				
Ground nesting	3.07	30	2.78	82
Ground-bush nesting	4.51	45	0	0
Bush-small tree nesting	2.33	23	0	0
Cattail, rush, sedge nesting	.20	2	.60	18



and American robin. Most of the birds in the non-willow habitat nested on the ground. The only exception was the red-winged blackbird, which we found nesting in tall, thick sedge communities near the stream.

Of the 13 species breeding in the willow-dominated beaver pond habitat, six (willow flycatcher, American robin, yellow warbler, song sparrow, red-winged blackbird, and Brewer's blackbird) nest in shrubs and feed on the ground, in bushes, or in the air. Each of those species is oriented to deciduous riparian plant communities for reproductive and feeding activities (Thomas 1979). The killdeer, spotted sandpiper, and common snipe nest on the ground, usually but not necessarily near water (Harrison 1979). At Summit Creek, we observed them most often near the beaver pond in mesic herbaceous communities dominated by grasses, sedges, and rushes. Of the four species breeding in the adjacent nonwillow habitat, three (vesper sparrow, savannah sparrow, and western meadowlark) nested and fed on the ground. Each is oriented to dry meadow plant communities for reproduction and feeding (Thomas 1979). In general, our observations of the habitats used by the birds breeding on the Summit Creek site generally support those reported by Douglas and Ratti (1984) for the Centennial Mountains of eastern Idaho.

Among the species found on the two study plots, only the American robin and Brewer's blackbird were assigned medium or high versatility ratings with respect to the number of plant communities used for reproductive or feeding activities; all others were given low versatility ratings by Thomas (1979). Five of the species found in the beaver pond complex at Summit Creek—the common snipe, willow flycatcher, yellow warbler, common yellowthroat, and song sparrow—appear ecologically dependent upon riparian vegetation for breeding habitat (Knopf and Samson 1988).

## CONCLUSIONS

We found sharply defined structural (physiognomic) differences in vegetation between a willow-dominated beaver pond complex and an adjacent nonwillow riparian habitat. Differences were most pronounced in the overstory layer where average values of shrub biomass, shrub height, and shrub canopy cover were significantly higher on the beaver pond site. Those differences, plus the availability of impounded water, were reflected in the composition and density of associated breeding bird populations. Our estimates of total breeding bird density, bird species richness and diversity, and total breeding bird biomass were markedly higher in the beaver pond habitat. Further, more foraging and nesting

guilds were represented in the beaver pond complex than in the adjacent riparian habitat. Our findings suggest that beaver pond ecosystems can provide important habitats for nongame breeding birds in the Western United States.

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Breeding bird populations and community organizations were compared between a beaver pond habitat dominated by willows and an adjacent nonwillow riparian habitat. Total bird density in the ponded habitat was three times that of the nonponded area. Bird biomass, bird species richness, and bird species diversity were 3.49, 3.25, and 1.67 times higher, respectively, in the beaver pond habitat.

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KEYWORDS: breeding birds, density, diversity, standing crop biomass, guilds

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