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AVIAN ECOLOGY
OF
NATURAL WOODLAND HABITATS
IN
SOUTHWESTERN NORTH DAKOTA

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Zoology Department
North Dakota State University
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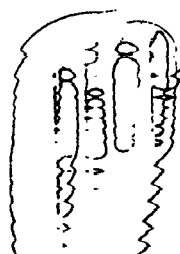
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ABSTRACT

Natural wooded areas in the Badlands region of southwestern North Dakota were studied for three years. Two sites in each of four wooded habitat types and two in grassland types supported few amphibians and reptiles. Of 17 mammal species, none showed specific habitat affinities although at least four species were found only in woodlands. Fourteen of the 16 species of birds seen in winter are year-round residents. Migrating and breeding birds show the most specific habitat affinities. Of 18 transient species, ten are principally ground gleaners, eight foliage gleaners. The foliage gleaners and all but two of the ground gleaners have specific woodland affinities.

Of 54 species of birds recorded as breeding, 39 were found only in woodlands. Sixteen species ranged over several woodland habitat types. Six were found in all deciduous areas, 12 species nested only in cottonwood forests, three only in mixed hardwood patches, and two only in the Ponderosa pine forest. None were found only in the juniper patches.

Wooded areas are rare in North Dakota. They have specific influence upon the occurrence and distribution of several bird and mammal species. We recommend that the natural wooded areas of southwestern North Dakota be preserved and protected.

PREFACE

Early in 1978, Ardell Bjugstad of the U.S. Forest Service and Harold Goetz and Frank Cassel of North Dakota State University initiated plans for investigating the vertebrates influenced by the natural wooded areas in southwestern North Dakota. In the fall of 1979, representative sites were selected for intensive study and a small mammal trapping program was completed. Birds were observed as the trapping was carried out, and subsequent emphasis was on avian habitat interrelationships.

Each area was visited several times during the winter and spring of 1979, but due to a late spring, intensive studies were not begun until May. Breeding bird territories were mapped in June under Wiehe's supervision. The plant community on each site was inventoried later in the summer.

Occasional visits to the sites continued through the fall and winter of 1979-1980. In late March, 1980, an intensive study of migrating birds was begun by Schwartz. This continued until breeding birds had established territories, which were then mapped by Hopkins and Schwartz.

As the drought of 1980 developed, cattle began to utilize the woodlands more than usual and we paid particular attention to their effects. In 1981, breeding bird territories were again mapped by Hopkins.

Concurrent with this investigation, other studies of natural wooded areas in North Dakota were in progress. In 1978 and 1979 Hoffman and Hopkins of the University of South Dakota studied habitats in Theodore Roosevelt National Park (Hansen et al. 1980). In 1979 and 1980 a NDSU Zoology team studied natural wooded areas, shelterbelts and old mine spoils under the

sponsorship of the North Dakota Game and Fish Department and the Bureau of Land Management (Hiemenz and Cassel 1980). In 1980, similar but more extensive inventories were made of the vertebrates on the Glenharold Coal Mine in Mercer and Oliver counties in central North Dakota (Fleckenstein et al. 1981). In 1981 a NDSU Botany team analyzed various other vegetational habitats in southwestern North Dakota for the U.S. Forest Service (Goetz et al. 1981).

We thank Jay Cassel, Greg and Nestor Hiemenz and Farron Wallace who participated in the field studies, and particularly Richard Williams of NDSU's Botany Department who supervised the ground cover analysis, and Charlotte Meester, Sheila Kath and Joyce Mortensen who typed many reports and drafts, including complicated tables, in good spirits. We especially thank Janelle Hopkins for her help with grammar and clarity of communication. Thanks also to Robert Powell, Chief Ranger of Theodore Roosevelt National Park, who granted us access to the study sites within the park as well as assisting us with many other problems including housing; to Douglas Paulson, Superintendent of the Chateau de Mores State Historical Site, (and to his predecessor Lawrence Mink) who permitted us to study the floodplain forest near the chateau; to Robert Hanson who provided a trailer site as well as permission to study in his Ponderosa pine forest; to Gerald Kobriger of the North Dakota Game and Fish Department who provided housing and advice from time to time; and to Harold Goetz and Thomas Conlon of the North Dakota State University Experiment Station who also provided housing and advice as well as mail and telephone service.

The standards for nomenclature, both common and scientific, used in this report are Stevens (1963), Wheeler and Wheeler (1966), A.O.U. Check-list of Birds (1957) as modified by the 32nd (1973) and 33rd (1976) supplements, and Wiehe and Cassel (1978, Jones et al. 1979).

J. Frank Cassel
1 April 1982

WHY ARE NATURAL WOODLANDS IMPORTANT TO NORTH DAKOTA?

North Dakota is a nearly treeless prairie state lying entirely within the Grassland Biome (Shelford 1963). Today the natural prairie vegetation is nearly gone, replaced by agricultural lands, mostly row crops and pastures. Native prairie and prairie potholes are the habitats that have declined most significantly. North Dakota's scant woodlands have also been depleted. In 1967, native woodlands (mostly floodplain forests and upland deciduous woods) occupied only two percent of the total state area. Over 438,000 acres of floodplain forest have been lost by the impoundment of water behind dams to create reservoirs for flood control and irrigation (Stewart 1975). Increasing pressure from agricultural, industrial and energy developments, including coal mining and oil exploration, continues to reduce the number of natural habitats.

In the fall of 1978, the U.S. Forest Service and North Dakota State University executed Cooperative Agreement No. 16-870-CA, and subsequently amended it twice. The objectives of the investigation which the Zoology Department of NDSU agreed to pursue were:

1. Provide descriptions of various habitat types (niches) associated with natural woodlands (woody draws) in west central and southwestern North Dakota.
2. Identification of the non-game vertebrates that need those habitats for breeding, winter and migratory purposes.
3. Determine specific description of habitats of wintering non-game birds.

4. Determine value of wooded areas for migrating non-game birds.
5. Compare areas open to livestock grazing with areas not grazed as habitats for resident and migratory non-game birds.

Field work began 15 September 1978. The goal of the agreement is to provide data to assess the value of natural woodlands to wildlife. This data provides a basis for making recommendations for reestablishing natural woodland habitats lost to the strip mining of lignite coal in the Northern Great Plains.

BIRD COMMUNITIES MEASURE HABITAT DIVERSITY

Eight natural wooded areas representing various habitat types and one prairie site were selected for study in the fall of 1978. An additional prairie site was selected in 1980 (Figures 1 and 2). The prairie sites represented the prevalent habitat type of the area.

Habitat Analysis

Vegetation of each site was sampled in the fall of 1978 and during the summer of 1979 with some specific emendations from 1981 analyses. Tree species composition and population structure were obtained by the point-centered quarter method. The percent composition (by ground cover) of grasses, forbs, and shrubs was estimated using a meter square quadrat at 20 random locations (James and Shugart 1970, Mueller-Dombois and Ellenberg 1974).

Occurrence of amphibians and reptiles on each site was recorded but no special collection techniques were used. Mammal sign and sightings were recorded and the presence of small mammal species documented by snap-trapping. Two 100 meter line transects with groups of three traps placed at 10 meter intervals were run for six nights in the fall of 1978. Because our previous small mammal population studies in North Dakota have shown that densities fluctuate greatly from year to year, season to season, and with the productivity of the habitat, no attempt was made to follow these fluctuations for the short term of this investigation.

NORTH DAKOTA

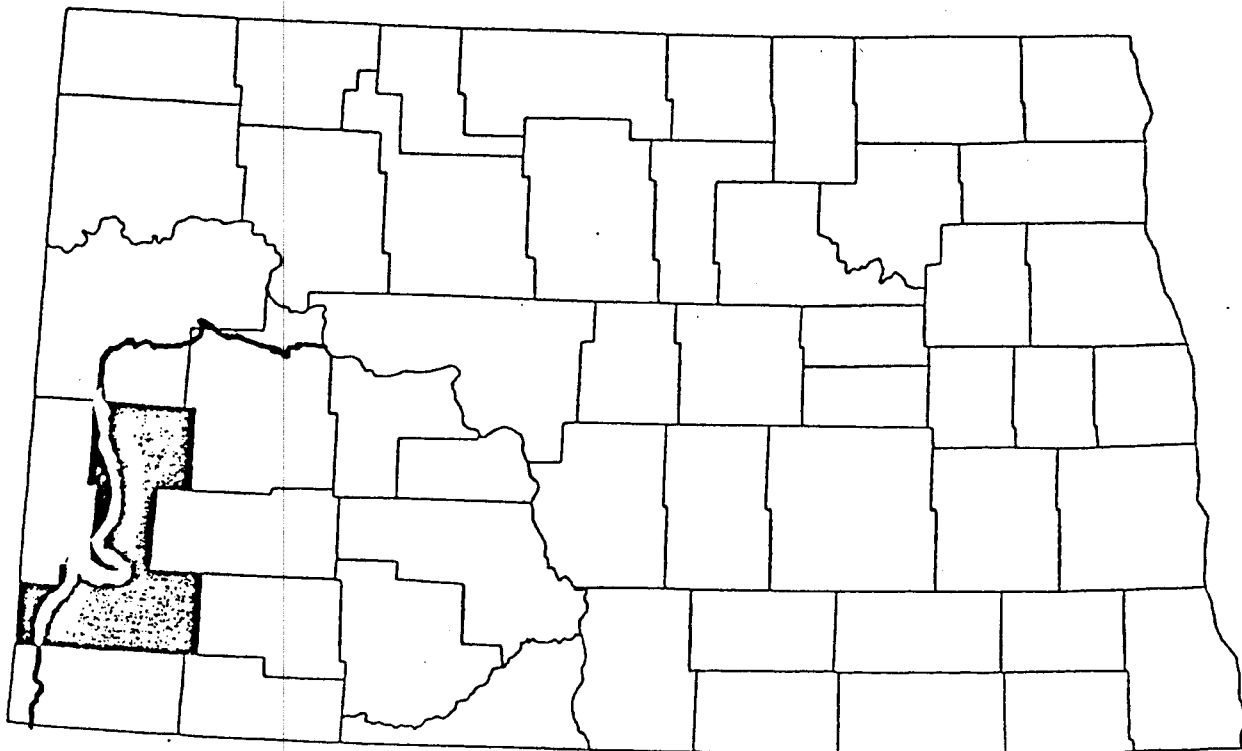


Figure 1. General region of study in southwestern North Dakota. The study sites are located in Billings and Slope Counties (shaded) near the Little Missouri River.

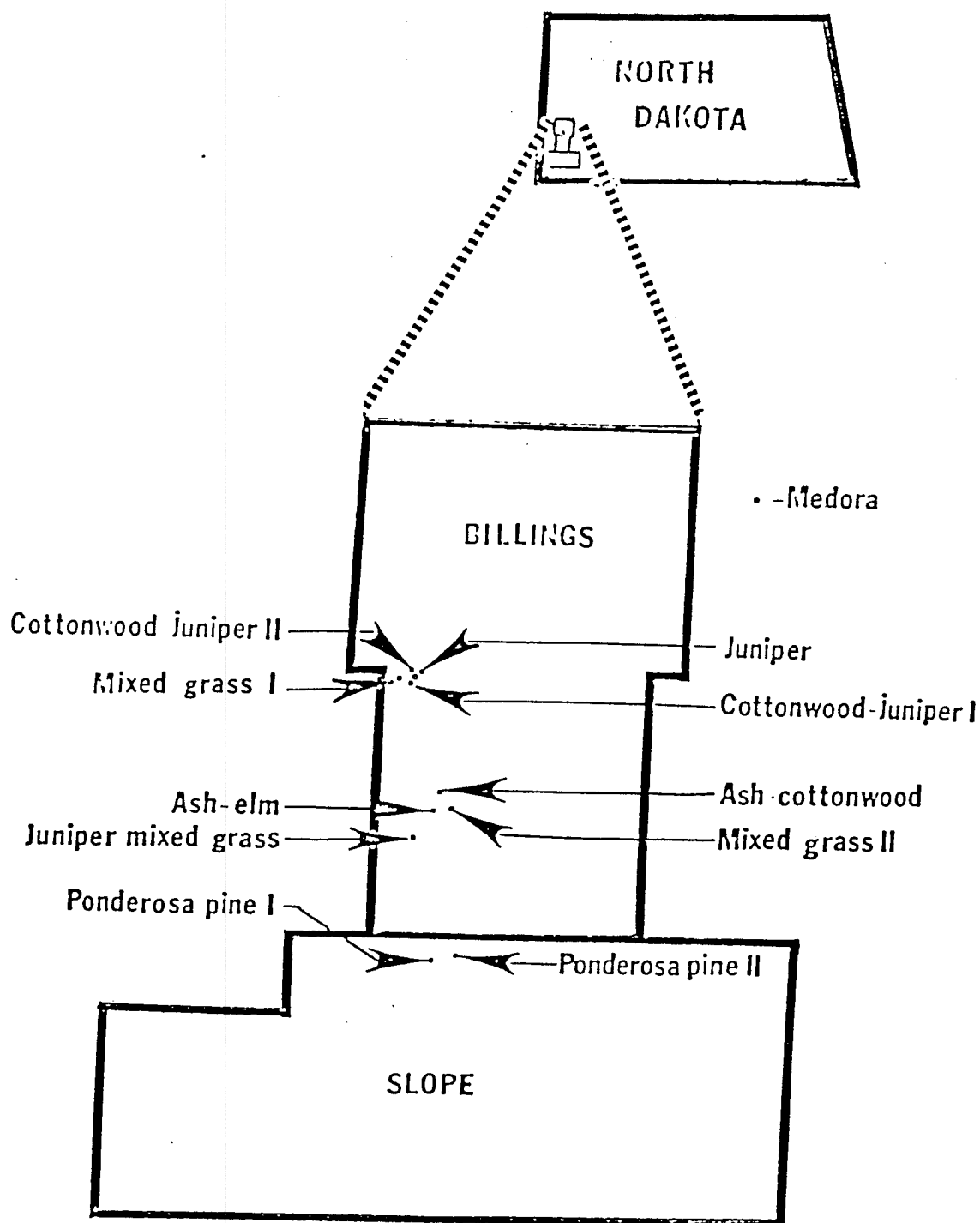


Figure 2. Location of the ten study areas in southwestern North Dakota.

TABLE 1

Study Site Data

Habitat Type	Acres	Terrain	Legal Descriptions	County and Location
Cottonwood-Juniper I	32	Floodplain	NW $\frac{1}{4}$, SE $\frac{1}{4}$, Sec. 27, T140N, R102W	Billings, 0.5 mi. SW, Medora
Cottonwood-Juniper II	47	Floodplain	NW $\frac{1}{4}$, SW $\frac{1}{4}$, Sec. 15, and SE $\frac{1}{4}$, SE $\frac{1}{4}$, Sec. 16, T140N, R102W	Billings, 1.7 mi. NW, Medora
Ash-Cottonwood	7	Draw Complex	SE $\frac{1}{4}$, SW $\frac{1}{4}$, Sec. 12, T138N, R102W	Billings, 9 mi. S, Medora
Ash-Elm	7	Draw Complex	SE $\frac{1}{4}$, NW $\frac{1}{4}$, Sec. 13, T138N, R102W	Billings, 10 mi. S, Medora
Juniper	4	Draw Complex	SW $\frac{1}{4}$, SE $\frac{1}{4}$, Sec. 15, T140N, R102W	Billings, 1.5 mi. N, Medora
Juniper-Mixed Grass	6	Draw Complex	SE $\frac{1}{4}$, NW $\frac{1}{4}$, Sec. 23, T138N, R102W	Billings, 11 mi. S, Medora
Ponderosa Pine I	50	Draw Complex	NW $\frac{1}{4}$, NW $\frac{1}{4}$, Sec. 21, T136N, R102W	Slope, 11 mi. NW, Amidon
Ponderosa Pine II	10	Draw Complex	NE $\frac{1}{4}$, SW $\frac{1}{4}$, Sec. 14, T136N, R102W	Slope, 9.5 mi. NW, Amidon
Mixed Grass I	10	Sloping Plain	SE $\frac{1}{4}$, SE $\frac{1}{4}$, Sec. 19, T140N, R102W	Billings, 3 mi. W, Medora
Mixed Grass II	25	Plain	SW $\frac{1}{4}$, NE $\frac{1}{4}$, Sec. 13, T138N, R102W	Billings, 10 mi. S, Medora
Transect	12.5 mile	Badlands	From: SW $\frac{1}{4}$, NW $\frac{1}{4}$, Sec. 11, T136N, R102W To: SW $\frac{1}{4}$, SW $\frac{1}{4}$, Sec. 23, T138N, R102W	Slope and Billings

Bird Populations

On the other hand, bird populations are fairly stable during both winter and summer, although they vary from year to year. Bird activity can be observed at all times of the year. By emphasizing the composition and dispersion of bird communities, the relative ecological effects of various wooded habitats can be evaluated in contrast to the effects of the surrounding grasslands.

Birds were observed in the fall of 1978, 1979 and 1980; the winter of 1979 and 1980; and spring-summer of 1979, 1980 and 1981. During the fall of 1978, birds were recorded during the period of mammal trapping. In January 1979 and January and February 1980, birds were recorded on all accessible sites. During May and June of 1979, April through June of 1980 and June 1981, each site was visited two or more times a week. Resource partitioning was carefully recorded both spring and fall of 1980, and in the spring of 1981. Nesting birds were counted using the International Standard Mapping Method recommended for the annual Audubon Breeding Bird Census (I.B.C.C. 1970, Hall 1964, Van Velzen 1972, Williams 1936).

HABITAT TYPES INVESTIGATED

Natural Woodlands

Crop and grazing land predominate in southwestern North Dakota. Trees occur most frequently in patches associated with the drainage contours of the steeply rolling Missouri Plateau and the unique terrain of the Little Missouri River Badlands. The flood plain of the Little Missouri has little grade. Meandering through a basin of varying width, it drops a thousand feet in its course of about 150 miles from the South Dakota border to its outlet into Lake Sakakawea. Bands and groves of hardwood forest grow on its flood plain. These forests are usually dominated by cottonwoods (Populus deltoides), and include green ash (Fraxinus pennsylvanica) and Rocky Mountain red cedar (Juniperus scopulorum). Some include American elm (Ulmus americana) and box elder (Acer negundo).

The drainage courses leading to the Little Missouri usually head at plains level, descend steeply, and then level out in the main basin. Steep-sided ravines associated with this terrain often support patches of deciduous trees and shrubs or junipers (Rocky Mountain red cedar). These patches, usually most profuse on the north-facing slopes or escarpments, are similar to the fragments or "habitat islands" discussed by Whitcomb (1977) and Robbins (1979). Green ash, American elm, quaking aspen (Populus tremuloides), and box elder occur in these "draws". Juniper is more frequent in drier sites.

In Slope County, south of the west-east flowing segment of the Little Missouri River, is North Dakota's main native pine forest (Pinus ponderosa)

covering about 3900 A. of river bluff and badland terrain (Potter and Green 1964). Mixed hardwoods grow in the moist bottoms along some drainages in the Ponderosa pine forest.

Two sites in each of four woodland types were studied. To distinguish those animals unique to the forest patches, two prairie sites were also studied. The legal description, location, and other data for these sites are shown in Table 1, and a summary of vegetational characteristics is included in Tables 2, 3, and 4.

Cottonwood Forest

The canopy in the cottonwood-juniper plots is dominated by cottonwood. The canopy height ranges from 45-80 feet and averages about 70 feet. Lower-crowned trees associated with this habitat include green ash and juniper. Junipers of various sizes are scattered throughout the plots. On the smaller plot they are more dense in the western portion.

The well developed shrub stratum includes buckbrush (Symphoricarpos occidentalis), skunkbush (Rhus trilobata), silver buffaloberry (Shepherdia argentea), and chokecherry (Prunus virginiana). Major grasses include Kentucky bluegrass (Poa pratensis) and Canada wild-rye (Elymus canadensis). Yellow sweetclover (Melilotus officinalis) and white sweetclover (Melilotus alba) are abundant in these stands.

The only reptile we encountered on these plots was the Bull Snake (Pituophis melanoleucus), although Hansen et al. (1980) found several other species of toads and snakes in similar habitats, Rocky Mountain Toads (Bufo woodhousei) being most frequent.

TABLE 2
Vegetation Analysis

	Cottonwood-Juniper I		Cottonwood-Juniper II		Ash-Cottonwood		Ash-Elm		Juniper		Juniper-Mixed Grass		Ponderosa Pine I		Ponderosa Pine II		Mixed-Grass I	
Ground Cover (%)	20	25	25	20	15	30	10	15	5	30	25	30	30	30	30	30	30	
Relative Cover Composition (%)																		
Forbs	40	25	15	10	10	10	10	5	5	5	5	5	5	5	5	5	5	
Graminoids	40	15	15	10	30	30	30	50	35	75	80	35	75	80	75	80	80	
Shrubs	20	60	70	80	60	80	60	45	60	20	15	60	20	15	20	15	15	
Trees/acre	80.0	75.1	126.0	214.6	437.3	382.0	105.7	153.7	105.7	153.7	--	105.7	153.7	--	153.7	--	--	
Basal area (ft ² /acre)	83.5	69.2	32.2	80.1	101.3	66.9	50.8	59.3	50.8	59.3	--	50.8	59.3	--	59.3	--	--	
Arboreal Canopy Cover (%)	85	70	90	70	65	60	35	50	35	50	--	35	50	--	50	--	--	

TABLE 3
Tree Species Composition

Habitat Type	Species	Trees/acre	Relative Dominance
Cottonwood-Juniper I	Cottonwood	47.0	92.7
	Rocky Mountain Cedar	31.0	7.0
	Green Ash	2.0	.2
Cottonwood-Juniper II	Cottonwood	40.6	91.6
	Rocky Mountain Cedar	32.5	8.0
	Green Ash	1.9	.3
Ash-Cottonwood	Black Cottonwood	54.0	81.0
	Green Ash	71.0	13.5
	Rocky Mountain Cedar	16.0	3.4
	Box-elder	6.0	2.2
Ash-Elm	Green Ash	146.6	65.2
	American Elm	60.0	34.0
	Rocky Mountain Cedar	5.3	.4
Juniper	Rocky Mountain Cedar	395.9	86.7
	Green Ash	40.6	13.2
Juniper-Mixed Grass	Rocky Mountain Cedar	338.4	82.8
	Green Ash	43.1	17.1
Ponderosa Pine I	Ponderosa Pine	100.3	97.5
	Green Ash	4.4	2.3
	Rocky Mountain Cedar	.8	.2
Ponderosa Pine II	Ponderosa Pine	152.4	99.7
	Green Ash	1.2	.1

TABLE 4
Tree Population Structure of Eight Woody Areas

Habitat Type	Tree Population Structure (DBH) ^a				
	3-6	6.1-9	9.1-15	15.1-21	21.1-27
	-----Trees Per Acre-----				
Cottonwood Juniper					
Cottonwood-Juniper I	22.7	9.3	12.7	29.3	6.0
Cottonwood-Juniper II	24.4	8.8	14.4	24.4	3.1
Mixed Hardwood Patches					
Ash - Elm	71.5	85.8	48.3	7.2	1.8
Ash - Cottonwood	69.3	30.1	26.6	0.0	0.0
Ponderosa Pine					
Pine I	35.2	30.0	37.0	2.6	0.8
Pine II	61.5	46.1	42.3	3.8	0.0
Juniper Patches					
Juniper	273.3	136.4	27.1	0.0	0.0
Juniper - mixed grass	320.0	51.9	8.4	0.0	0.0

^aDiameter breast height in inches.

Coyotes (Scientific names - see Appendix IV) and White-tailed Deer range through these forests, and in Theodore Roosevelt National Park, Bison sometimes graze on the plot. Cottontails, Least Chipmunks, Fox Squirrels and Northern Pocket Gophers breed in these areas (Table 5). Small mammals trapped on these plots included the Deer Mouse, White-footed Mouse, Meadow Vole and Prairie Vole (Table 6). The mice were trapped much more frequently than voles, as would be expected in wooded areas.

Mixed Hardwood Patches

The canopy in the ash-cottonwood plot is dominated by green ash and black cottonwood (Populus trichocarpa). In North Dakota, black cottonwood is unique to this site (Stevens 1963). The canopy height ranges from 15-60 feet and averages 45 feet.

The dominant canopy trees in the ash-elm plot are green ash and American elm. The canopy height ranges from 15-40 feet and averages about 30 feet.

The understory is similar in both sites. The most prominent shrubs are western wild rose (Rosa woodsii), buckbrush, chokecherry and silver buffaloberry. The herbaceous vegetation is dominated by Kentucky bluegrass, little ricegrass (Oryzopsis micrantha) and northern bedstraw (Galium boreale). Heavy cattle use in these areas has resulted in sparse ground cover.

The Dakota Toad (Bufo hemiophrys) was found on the cottonwood-ash site. Racers (Coluber constrictor), Bull Snakes and Prairie Rattlesnakes (Crotalis viridis) were reported by Hansen et al. (1980) in similar habitats.

TABLE 5

Mammals Observed on Study Plots
(including those trapped)

Species	Habitat Plot		Cottonwood-Juniper I	Cottonwood-Juniper II	Ash-Cottonwood	Ash-Elm	Juniper	Juniper-Mixed Grass	Ponderosa Pine I	Ponderosa Pine II	Mixed Grass I	Mixed Grass II
Eastern Cottontail*							X					
Desert Cottontail										X		
Cottontail (unident.)			X	X		X		X				
Least Chipmunk			X	X	X	X	X	X	X			
Thirteen-lined Ground Squirrel												X
Fox Squirrel				X								
Northern Pocket Gopher			X		X		X		X	X	X	
Deer Mouse			X	X	X	X	X	X	X	X	X	
White-footed Mouse			X	X	X	X	X	X				
Meadow Vole			X	X			X					
Prairie Vole				X			X	X	X		X	
Porcupine					X	X		X	X	X		
Coyote			X	X		X	X	X				
Mule Deer							X	X		X		
White-tailed Deer			X	X			X		X	X		
Pronghorn											X	
Bison			X									
Mountain Sheep					X							
Total species			9	9	6	6	10	8	6	6	4	1

-not trapped-

*Scientific Names-Appendix IV

TABLE 6
Summary of Small Mammal Trapping
(25 September - 19 October 1978)

Habitat Plot	Total Trap Nights	<i>Eutamias minimus</i> #	Per 100 T.N.	<i>Peromyscus maniculatus</i> #	Per 100 T.N.	<i>Peromyscus leucopus</i> #	Per 100 T.N.	<i>Peromyscus</i> sp. (undiscriminated) #	Per 100 T.N.	<i>Microtus pennsylvanicus</i> #	Per 100 T.N.	<i>Microtus ochrogaster</i> #	Per 100 T.N.	Total Catch	Total Per 100 Trap Nights
Cottonwood Forest	749													152	20.6
Cottonwood-Juniper I	376	1	0.3	68	18.1	6	1.6	2	0.5	8	2.1	--	--	85	22.6
Cottonwood-Juniper II	373	--	--	20	5.4	41	11.0	1	0.3	4	1.1	3	0.8	69	18.5
Mixed Hardwood Patches	747													78	10.3
Ash-Cottonwood	382	--	--	16	4.3	21	5.6	11	2.9	--	--	--	--	48	12.6
Ash-Elm	375	--	--	20	5.2	2	0.5	8	2.1	--	--	--	--	30	8.0
All Hardwoods	1506	1	.06	124	8.3	70	4.7	20	1.3	12	0.8	3	0.2	230	15.4
Juniper Patches	774													56	7.2
Juniper	388	4	1.0	29	7.5	1	0.3	--	--	1	0.3	2	0.5	37	9.5
Juniper Mixed Grass	386	--	--	13	3.4	5	1.3	--	--	--	--	1	0.3	19	4.4
Ponderosa Pine Forest	790													11	1.4
Ponderosa Pine I	395	--	--	2	0.5	--	--	--	--	--	--	3	0.8	5	1.3
Ponderosa Pine II	395	--	--	6	1.5	--	--	--	--	--	--	--	--	6	1.5
All Evergreens	1564	4	0.3	50	3.2	6	3.2	--	--	1	.06	6	0.4	67	4.3
All Wooded Habitats	3070	5	0.2	174	5.7	76	2.5	22	0.7	13	0.4	9	0.3	297	9.7
Mixed Grass Rangeland															
Mixed Grass I	373	--	--	20	5.4	--	--	--	--	--	--	10	2.7	30	8.0

N.B. -- Mixed Grass II was not trapped.

*Common Name-Appendix IV

We recorded Cottontails, Least Chipmunks, Northern Pocket Gophers, Deer Mice, White-footed Mice, Porcupines and Coyotes. Mountain Sheep ranged through this area, being seen on the Ash-Cottonwood site (Table 5). The two species of mice were the only small mammals trapped (Table 6).

Juniper Patches

The overstory in the plots is dominated by Rocky Mountain red cedar, but scattered green ash are also found. In the denser stands the trees reach 15-20 feet in height.

Dominant shrubs include creeping juniper (Juniperus horizontalis), dwarf juniper (Juniperus communis), buckbrush, skunkbush, and silver buffaloberry. Some of the common grasses include little ricegrass, little bluestem (Andropogon scoparius), western wheatgrass (Agropyron smithii), blue grama (Bouteloua gracilis) and big sandgrass (Calamovilfa longifolia). Both sites are situated in the rugged badlands terrain. The juniper-mixed grass draw is grazed by livestock during the summer.

No reptiles or amphibians were encountered in the juniper areas either by Hansen et al. (1980) or by us. Coyotes, Mule Deer and White-tailed Deer use juniper areas, and a young Porcupine was found on the juniper-mixed grass site. Cottontails and chipmunks found refuge and nesting sites here as did the White-Footed Mouse and, particularly, the Deer Mouse. Voles were infrequent (Table 6).

Ponderosa Pine Forest

The canopy in the pine forest is dominated by Ponderosa pines. Other tree species include green ash (associated with drainages) and junipers.

The "canopy" height ranges from 20-50 feet and averages about 40 feet.

The shrub stratum is principally buckbrush and creeping juniper. In many places the shrub layer is sparse or non-existent, especially under the more dense pine stands. A carpet of pine needles prevails, particularly on the larger plot.

Most abundant grasses include little bluestem, big sandgrass, needle and thread (Stipa comata), and bluebunch wheatgrass (Agropyron spicatum). Grasses are most dense in the open, savanna-like portions of the pines on ridge tops. The pines area shows evidence of ground fires, heavy grazing by cattle, and seismograph test holes, which were frequent in 1980.

The Racer was seen in this area. White-tailed and Mule Deer used the pines; and tree trunks showed evidence of Porcupine foraging. Pocket Gopher turnings were frequent on both sites. Least Chipmunks were found on the larger site, and a Desert Cottontail on the smaller area (Table 5). Compared with the other wooded habitats, few small mammals were trapped in the pines. Only two species, the Deer Mouse and the Prairie Vole were represented (Table 6).

Rangeland

Since the principal vegetation in the Badlands is grass, two sites representing this habitat were included in our investigation. Heavily grazed in most areas, the rangeland provides little cover for wildlife. Some species, such as the Horned Lark and the Deer Mouse, thrive under these circumstances. Larger mammals such as coyotes and deer utilize both range and woodlands. Deer browse on the short shrubs common to the range. Hence, their occurrence does not necessarily demonstrate any unique attractiveness of woodlands to these animals.

The vegetation of the mixed-grass prairies is dominated by western wheatgrass, blue grama, needle and thread, big sandgrass, and little bluestem. Threadleaf sedge (Carex filifolia) occurs in dense patches. Shrubs are found at scattered locations and include dwarf sagebrush (Artemesia cana), creeping juniper and buckbrush. Both of the prairie sites are grazed. The vegetation on these areas was poorly developed in 1980 because of drought conditions.

The Thirteen-lined Ground Squirrel and the Pronghorn were seen only on the range. Pocket Gophers, Deer Mice and Prairie Voles inhabit both grassland and woodland areas (Tables 5 & 6).

BIRD COMMUNITIES

Winter Birds

Few birds brave the rigors of North Dakota winters. They tend to range more widely than during the breeding season. Therefore, estimates of comparative density estimates can be misleading because the likelihood of the observers and the birds intercepting each other during their wanderings is fortuitous. Table 7 lists the species recorded in each habitat type.

Several bark foraging species form the core of winter bird communities in North Dakota. Hairy and Downy Woodpeckers, Blackcapped Chickadees, and White- and Red-breasted Nuthatches were found on mature woodland sites which also provide roosting holes.

The Red Crossbill is specialized for foraging on pine cones. Waxwings and robins are fruit and seed eaters. The Bohemian Waxwing was the only bird recorded regularly which does not also breed in this area. The owls are not restricted to woodlands, but utilize them for foraging because their prey species tend to occur there. The crow and magpie range widely, using wooded areas for perching and foraging.

Of the 15 species regularly occurring, ten are seldom, if ever, found outside wooded habitats. The Red-breasted Nuthatch and Red Crossbill prefer pines, while the others prefer mature deciduous woodland.

TABLE 7
Winter* Birds Observed

Species	Cottonwood Juniper Floodplain I	Cottonwood Juniper Floodplain II	Ash-Cottonwood Draw	Ash-Elm Draw	Juniper Draw	Juniper-Mixed Grass Draw	Ponderosa Pine I	Ponderosa Pine II	Grassland Control
R Golden Eagle			X		X				
R Sharp-tailed Grouse			X		X				
R Great Horned Owl			X						
R Short-eared Owl	X			X		X			
R Hairy Woodpecker	X	X							
R Downy Woodpecker		X							
R Black-billed Magpie	X	X			X	X		X	
R Common Crow	X								
R Black-capped Chickadee	X			X					
R White-breasted Nuthatch		X					X	X	
R Red-breasted Nuthatch									
R Am. Robin	X				X	X	X		
A Townsend's Solitaire		X							
W Bohemian Waxwing	X	X							
R Cedar Waxwing	X								
R Red Crossbill									
Total species	8	6	3	2	4	3	X	2	0
Species present:									
R-Year round									
W-Winter only									
A-Accidental									

no species observed in 1980
(not visited in 1979)

*Jan. 20-21, 1979 - Cassel and Wiehe
Jan. 3-5, 1980 - Hiemenz, Schwartz and Wallace
Feb. 1-3, 1980 - Hiemenz and Schwartz

Migrating Birds

Use of Habitat

The way a bird uses a habitat is important to understanding community functions (Root 1967, Willson 1970). Little is known of the role of habitat in the life of individual populations, or of the interaction of populations within a community. One means of analyzing these interactions is through the guild concept. Guilds are used to classify species according to common affinities. One species can be a member of several different guilds as determined by behavioral preferences.

The guild concept has been applied in a variety of ways. Sturman (1968), Willson (1970), Williamson (1971), and Eckhardt (1979) analyzed specific guilds or restricted their studies to taxonomically related individuals. Most investigators have concentrated on breeding birds or permanent residents. Austin (1976) and Travis (1977) studied seasonal foraging patterns of individuals of one species. Few studies have included migrating birds.

Most migrating birds utilize a habitat for only a short period. The habitats visited by these birds must provide sufficient resources for their continuing migration. Determining the foraging behavior of birds during migration (on similar and dissimilar habitats) provides a means of assessing the value of various habitats and habitat types to migrating birds.

Spring

Birds migrating through the badlands area were studied from 27 March to 27 May 1980. The eight natural woodlands and two prairie control sites emphasized in this report were studied intensively (Figure 2). In addition, a 12.5 mile census route along local roads (Robbins 1978) provided an index of migratory birds over a broader area (Figure 5). All woodlands and one prairie site (10 A) were visited a minimum of 20 times during the study (maximum 22). The other prairie site (25 A) was visited only nine times because it was added to the study later in the season. This site was added because it was a more homogeneous grassland than the first site. Early in the season the 12.5 mile route was censused as often as the woodlands and prairies (2 or 3 times per week). Later this count was conducted once a week. Field data were collected between 0450 and 1850 hours, regardless of weather conditions.

The plot census method (Kendeigh 1944) was used because of the irregular size and shape of the sites. Stationary observation points were established in various microhabitat types on each study site. The number of points established was proportional to site size and the microhabitats available. Three points were used on the prairies, in the juniper draws, and on the smaller Ponderosa pine site; four were used in the mixed hardwood draws, and six on the cottonwood-juniper forest and larger Ponderosa pine site. All birds seen or heard from these points during a ten minute period were recorded. The ten minute stops allowed time for observation of wandering individuals or groups, provided an inventory of the different microhabitats, and allowed time for hiding birds to resume activity. Care was taken at

adjacent points to prevent overlap in data recording.

Bird species and activities were also recorded along the transect between stops. The same route was taken each time, except when unrecognized species were pursued to determine their identity.

Foraging and other habitat data were recorded on a field sheet for activities occurring within approximately 15 seconds of initial visual contact. The field sheet (Figure 3) was organized for rapid recording of data relevant to guilds classified by foraging modes, singing, and perching height (Anderson et al. 1979).

Foraging Guilds

Foraging guild types included:

Ground Gleaning -- activity directed specifically at the ground. Since few insects were present early in the season, no effort was made to distinguish between seed foraging and insect foraging.

Bark Feeding

Drilling -- sharp rapping or chiseling motion.

Trunk Gleaning -- probing or prying motion on trunk.

Branch Gleaning -- probing or prying motion on branches.

Foliage Gleaning -- searching blades of grass, or leaves of forbs, shrubs, or trees.

Hawking (also called "sallying") -- active air attack or search.

Activity Height

Height levels were distinguished as:

Ground -- the bird was observed on the ground.

Low -- the bird was seen in the lower aspect of shrubs, conifers, and junipers, and below deciduous tree canopy.

Medium -- the bird was seen in the "mid-section" of shrubs, conifers, and junipers, or in the lower half of deciduous tree canopy.

High -- the bird was seen in the upper aspect of shrubs, conifers, and junipers, or in the upper half of deciduous tree canopy.

The dispersion of foliage on shrubs, conifers, and junipers necessitated the exclusion of terms such as "subcanopy," "lower canopy," and "upper canopy." If, for instance, an American Robin was sighted in a nine foot (3m) juniper, the lower three feet (1m) would be "low," the three to six foot region (2m) "medium," and the six to nine foot zone (3m) "high."

Numerical data were converted to birds per 100 acres (40 hectares). The information theory index (Shannon and Weaver 1963) was used to assess guild and height specialization. This index, sometimes referred to as the Shannon-Weiner function, is calculated using the formula:

$$H' = -\sum_{i=1}^N P_i \log_e P_i \quad \text{where,}$$

H' is the index of diversity. N is the number of categories being tested (number of species or number of guilds "richness"). P_i is the proportion of individuals in each of the categories being tested ("evenness"). The higher the value of H' , the greater the diversity.

Species recorded less than five times in any one category (e.g., the categories of "hawking" or "low shrub") were not analyzed statistically. Parametric (Sokal and Rohlf 1973) and nonparametric (Conover 1971) statistical tests were regarded significant for $P < .05$.

Fall

The sites were also studied from 13 September - 14 October 1980, using the same field sheet as in the spring. The prairie sites were censused four times. All other study areas were visited at least six times (cottonwood-juniper, eight times; ash-cottonwood, seven). The miniroute was covered once.

Habitat Relationships

Numerical Diversity

The degree of isolation and community development might be expected to affect the diversity and behavior of the birds in restricted habitats. Our observations of habitat selection by migrating birds seemed to conform to this theory. The numbers of species observed during spring and fall migration are shown in Table 8. In both seasons, species richness was greater from grassland, to juniper patch, to Ponderosa pine forest, to mixed hardwood, to cottonwood-juniper. Differences in richness of these types of habitat were tested with Duncan's multiple range test. The cottonwood-juniper sites had significantly greater ($P < .05$) species richness than the other habitat types. In the spring the mixed hardwoods and Ponderosa pine sites differed ($P < .05$) from the juniper and grassland sites. In the fall, however, the mixed hardwood sites differed ($P < .05$) from the Ponderosa pines as well as from the juniper and grassland sites.

A great difference was noted between the number of spring migrants and the number of fall migrants. The fewer birds recorded in fall migration may be due to:

1. The spring birds migrate in waves occurring simultaneously with the blooming of plants that attract insects and therefore insect-eating birds. Seasonal change in the fall or even late summer is much more gradual. Temperatures decline slowly, leaves fall, and insect densities are reduced, probably resulting in a more gradual movement of birds.

TABLE 8
Spring and fall bird species values

Habitat Type	Habitats (Study sites)	Number of species observed		Average individuals per 100 A.* per trip	
		Spring	Fall	Spring	Fall
COTTONWOOD-JUNIPER FOREST	Larger Cottonwoods (47 A.)	46	18	93	29
	Smaller Cottonwoods (32 A.)	41	18	71	78
MIXED HARDWOOD PATCHES	Ash-Cottonwood	35	10	388	58
	Ash-Elm	30	15	187	169
JUNIPER PATCHES	Juniper-Mixed Grass	18	4	93	42
	Juniper	12	6	119	228
PONDEROSA PINE FOREST	Large Pine (50 A.)	28	5	31	8
	Small Pine (10 A.)	26	8	76	70
GRASSLAND	Mixed Prairie	12	2	24	5
	Mixed Grass Prairie	7	2	20	9

*Refers to total number of individuals calculated per 100 A. for the entire censusing period for a per census basis. 100 A. is approximately 40 hectares. Acres are used because this area measurement is still standard in American land description.

"Spring" includes trips between 28 March and 27 May (20-22 trips, except Mixed Prairie-9). "Fall" includes trips between 13 September and 14 October (6-8 trips).

2. A major movement of birds begins directly following breeding. Initially this movement may simply include foraging over a wider area after the nesting territory is no longer defended. It may also include erratic wandering. In the late summer, wandering is sometimes southward and blends into early migration. Hence, birds counted in September and October may not include these late summer, southward movements.
3. A different pathway may be taken in the fall from the one used in spring. Fall migrants may utilize corridors to the west or east, away from the Badlands.

Relative density was estimated for each study site (Table 8). The results are inconclusive. Extreme variation occurs even among similar study sites. Inconsistencies are not specific to area size or community development. The results can be affected by flocking birds. Although each study site was visited frequently, individuals or even large flocks present for only a short time could have been missed. This potential, however, does not diminish the importance of the data upon which our analysis is based. Generalizations based on such analysis are still instructive in determining how birds utilize the habitats studied.

Guild Structure

A guild may be defined as "a group of species that exploit the same class of environmental resources in a similar manner without regard to taxonomic position" (Root 1967). The use of the guild concept directs attention to all species regardless of taxonomic similarity. The guild helps define a set of conditions which attracts each species or group of species to a habitat type. It also helps in comparing communities where it is impractical to consider all species using an ecotype. Salt (1953) and Root (1967) discussed guilds and their classification. Their approach (with modification) has formed the basis for our terminology.

Foraging guilds were determined for spring and fall (Figure 4). Foliage gleaners were predominant in all woodland sites. On the grassland sites, hawking and ground gleaning predominated. In undisturbed grassland, birds would be expected to pick seeds from grass and forb heads. On our sites, however, grazing cattle had utilized vegetative growth leaving few seed bearing heads. Prairie sites are open and more accessible to raptors and ground feeders. So few birds were found on the prairie in the fall that no generalizations can be made about activity and utilization.

Drilling species were scarce in all woodlands except the cottonwood-juniper forest. The juniper patches lacked drilling species altogether. Bark gleaning species occurred often on these sites but were more prevalent in the pines. The nature of the bark of different tree species and the relative occurrence of snags may be paramount in predicting what guilds

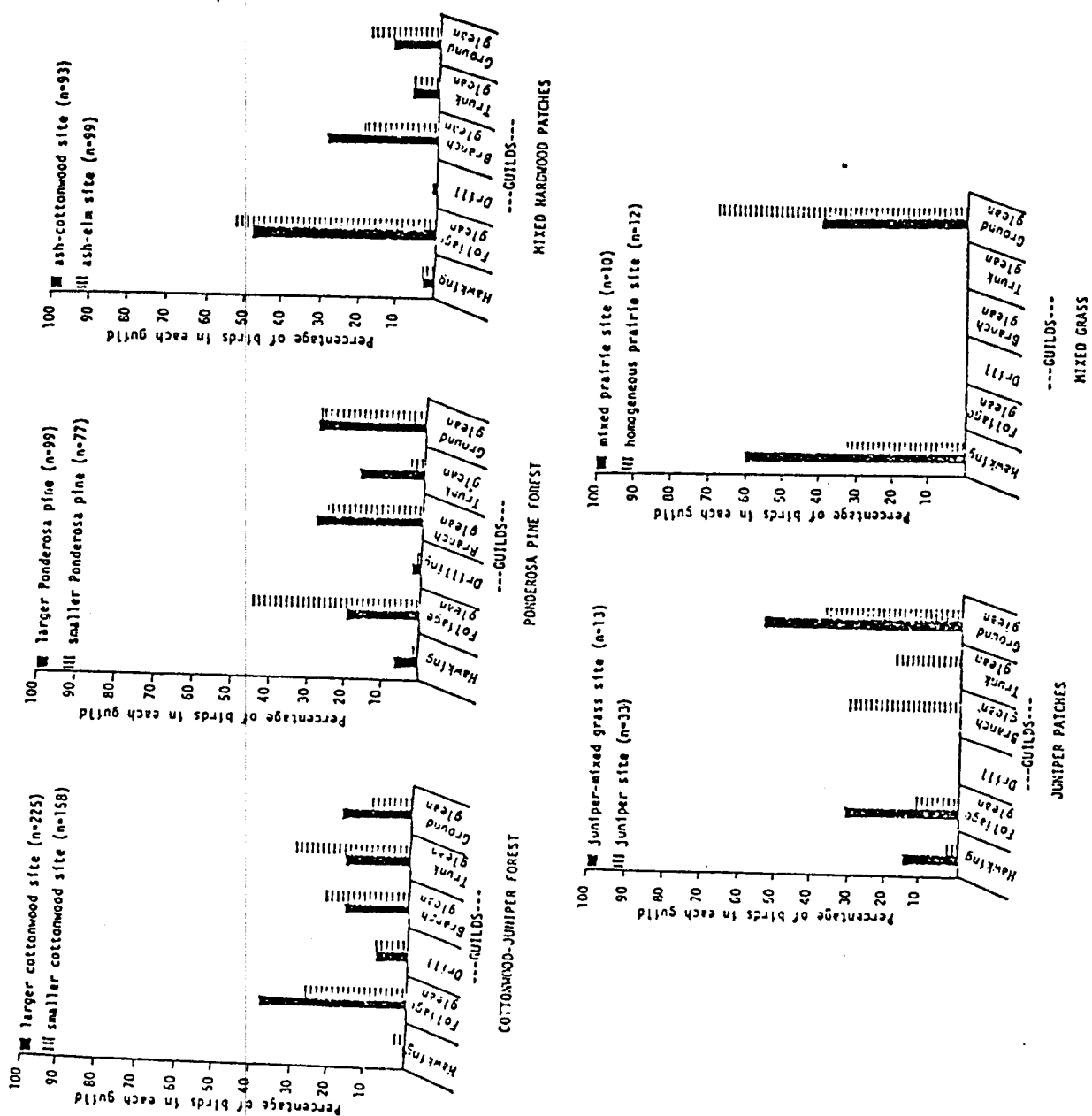


Figure 4. Guild distribution on the study areas.

use particular areas. The importance of rough-barked tree surfaces for overwintering insect larvae and pupae has been discussed by MacLellan (1959). Insect larvae are critical to the survival of many winter birds. Smooth-barked trees provide little or no protective or supportive substrate for overwintering invertebrates, compared with furrowed (mature cottonwood) or flaky barks (Ponderosa pine and juniper) (Travis 1977). Flaky barks are more accessible to probing and prying species (branch and trunk gleaning), while drilling is more frequent on furrowed or smooth-barked trees. Because smooth-barked trees contain fewer invertebrates, however, fewer birds utilize this substrate. Travis (1977) also found that wintering Downy Woodpeckers restricted their foraging to tree trunks. He suggested that trunks may protect both invertebrates and birds in inclement weather. On our sites, branch gleaning was more frequent than trunk gleaning during migration. This seasonal shift may be the result of improved weather conditions and movement toward invertebrates relatively untouched during winter foraging.

Residency Status and Guilds

Fall and spring bird species were grouped as:

Resident -- present throughout the year, nest.

Breeding -- present in summer, nest.

Transient -- using an area as a "stopping off place" during migration.

Winter Visitants -- found in January or February but not in the summer.

The arrival date and departure dates of transients during 1980 are graphed in Figure 5. During the spring season of migration (28 March - 27 May) all birds were classified by foraging guild regardless of their residing status (Figure 6). Because of their low density, fall birds were not analyzed.

Of resident birds recorded during the spring (Figure 6), 76 percent were bark feeders, 13 percent were ground gleaners, and 10 percent were foliage gleaners. Raptors and sallying (hawking) birds constituted one percent of the observations.

During the spring, breeding birds were seen foraging on the ground (39%) or in foliage (32%). Breeding birds include fewer bark searchers (16%) but more salliers than resident birds.

Transient birds (Figure 6) were almost totally specialized in foliage (76%) and ground gleaning (18%). Few birds were observed bark feeding (5%) and hawking (1%).

The guild status of birds is largely affected by the seasonal nature of north temperate vegetation and species food requirements. Resident

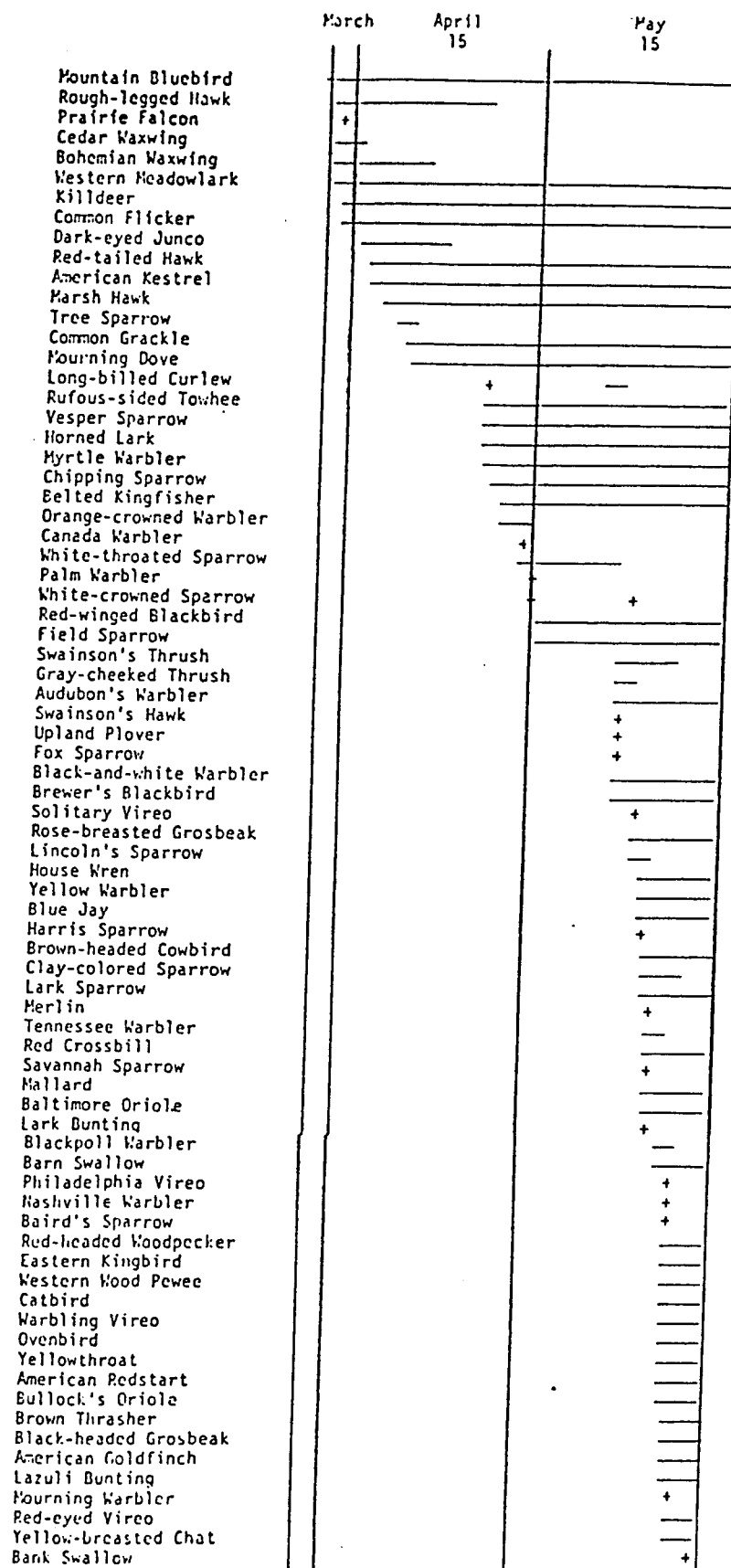


Figure 5. Approximate dates of occurrence of birds migrating during the spring of 1980.

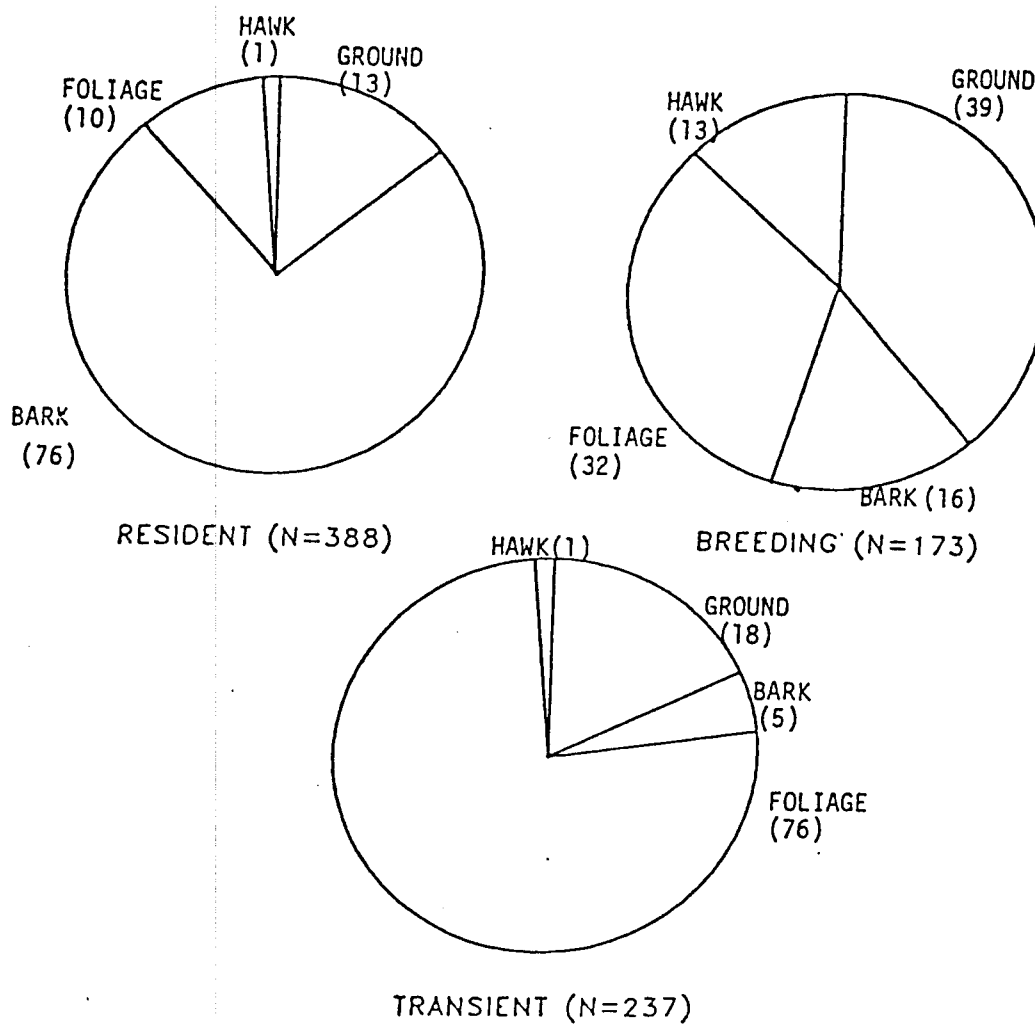


Figure 6. Percentage of Resident, Breeding and Transient birds observed in each guild.

birds must be primarily dependent on food reserves in bark when foliage is lacking and the ground is covered with snow (Table 9). Some of the residents have adapted to removing snow to uncover seeds, or they feed on berries of plants above the snow. With foliage emergence in spring, residents opportunistically shift their foraging patterns to utilize more available resources. Breeding birds do not need to depend on tree surfaces for food because climatic conditions have improved by the time they arrive (Figure 5).

The raptors usually arrive early, taking advantage of emerging animals. Before foliage emergence, waxwings foraged almost entirely on juniper berries from trees and ground. After the foliage has developed, ground and foliage gleaning birds become more abundant.

Transient birds do not show the diversity of foraging habits expressed by resident and breeding birds during migration. Transients require food sources that will quickly replenish depleted fat deposits so migration may continue. Insects associated with flowering plants and newly developing foliage on deciduous trees and shrubs provide an easily exploited energy source.

TABLE 9
Shift in Guild Status Following Foliage Development

	Ground glean	Wood glean	glean	Hawk	<u>Total</u>
Resident					
before*	13(32)***	82(197)	4(9)	1(2)	67(240)
after**	12(18)	66(98)	21(30)	1(2)	33(148)
Breeding					
before	5(1)	11(2)	-----	84(16)	5(19)
after	44(67)	16(25)	36(55)	4(7)	34(154)
Transient					
before	50(51)	1(1)	49(50)	-----	28(102)
after	5(8)	7(11)	87(130)	1(2)	33(151)
				before	100(361)
				after	100(453)

* before deciduous foliage has developed

** after initiation of foliage development

*** percent (n)

Height Level Utilization

Heights at which birds vocalize (sing or call) or just perch indicate another use of habitat. Levels utilized relative to the height of the vegetation are recorded in Table 10. Birds sang or perched primarily in the tree canopy. The relative position in the canopy was not critical (Mann-Whitney U-test, $P < .05$).

Habitat Preference

The information theory index (page 25) was applied to guilds, song height and perch height (Table 11). The smaller the value obtained, the greater the specialization toward a particular guild or height level.

Because grassland habitats are more uniform in aspect than woodlands, the lowest indices were recorded here. Only two guilds were observed utilizing these sites. The cottonwood-juniper floodplain forest, on the other hand, provided the most varied habitat as indicated by lower specialization. The broad range of guilds observed on these sites may be related to the more complex vegetational structure of the area.

The guild data were combined for each habitat type (Table 11). The guild indices parallel the number of species observed on those habitat types (Table 12). Increased habitat complexity attracts a greater number of species. It also provides opportunity for increased diversity of bird guilds capable of exploiting the greater resources available.

The combined indices for song and perch height level did not conform to the comparative relationship indicated by analysis of guilds. The prairie sites still remain unattractive since few places are available for perching and singing. The song and perch indices are a function of

TABLE 10. Song and perch height levels used by birds during spring migration (in percent)

	Cottonwood- Juniper I (Small cottonwood)	Cottonwood- Juniper II (Large cottonwood)	Ash- Cottonwood	Ash-Elm	Juniper	Juniper Mixed Grass	Ponderosa Pine I (Large)	Ponderosa Pine II (Small)	Mixed Grass I	Mixed Grass II										
High tree	20 ^b	25 ^c	45	25	13	27	59	66	46	63	32	36	15	17	34	33	9	15	--	--
Medium tree	61	53	45	26	55	38	31	28	35	21	23	15	58	35	31	36	5	--	--	--
Low tree	6	.9	2	23	14	5	4	5	15	14	12	13	10	31	12	12	--	--	--	--
High shrub	3	4	1	1	6	9	1	1	--	2	19	19	1	3	1	2	50	65	33	13
Medium shrub	3	4	3	23	4	13	2	1	--	--	--	4	5	--	15	2	--	--	--	--
Low shrub	3	2	2	1	5	5	2	1	--	--	--	--	1	11	3	--	--	--	22	--
Ground	4	3	2	1	3	3	1	--	4	--	14	13	10	3	4	15	36	20	45	87

^aSee page 25 for explanation of height classification.

^bThe first column under each habitat contains the percentage of birds singing at a certain height.

^cThe second column contains perching height percentages.

Table 11. Spring habitat preference indices*

Habitat type and study site	Guild (n=6)**	Combined (Habitat types)	Song level (n=7)	Combined (Habitat types)	Perch level (n=7)	Combined (Habitat types)
Cottonwood-juniper smaller cottonwood	1.576	2.235	1.236	1.821	1.328	1.771
larger cottonwood	1.510		1.089		1.479	
Mixed Hardwood Patch ash-cottonwood	1.299	1.971	1.427	1.607	1.591	1.454
ash-elm	1.258		1.009		0.847	
Ponderosa Pine larger pine	1.575	1.881	1.304	2.089	1.462	1.896
smaller pine	1.280		1.567		1.403	
Juniper Patch juniper	1.401	1.807	1.137	1.905	0.971	1.864
juniper-mixed grass	0.984		1.542		1.628	
Mixed Grass mixed prairie	0.673	1.290	1.073	1.447	0.887	1.352
homogeneous prairie	0.637		1.061		0.387	

* Lower value indicates greater tendency towards bird specialization.

** "n" refers to the number of guilds or number of levels tested.

Table 12. Comparison between total number of species and guild preference indices for the habitat types.

Habitat type	Total number of species	Combined guild index
Cottonwood-juniper	55	2.235
Mixed hardwood patch	45	1.971
Ponderosa pine forest	36	1.881
Juniper patch	23	1.807
Mixed grass	18	1.290

the availability of protected perches and singing sites. The Ponderosa pines and the juniper patches are probably more attractive to perch generalists because coniferous growth provides cover and perch sites at more levels than do mature deciduous trees, particularly prior to leaf development. Shrubs and deciduous trees associated with coniferous stands provide additional perch height levels.

Species Interactions

Guilds

The guild activity of each bird species observed is presented in Figures 7 and 8. The arrangement of the species in the figures facilitates comparison of birds specializing in the same or similar guilds.

Three species observed in the fall were not observed foraging in sufficient numbers during spring counts to determine their guild status. The Orange-crowned Warbler primarily gleaned from the foliage, while the Common Flicker and Black-billed Magpie foraged on the ground.

The Marsh Hawk, Red-tailed Hawk and American Kestrel were seen foraging in the spring. Although hawks were observed in the fall, none were seen foraging.

Woodpeckers seen on the study sites can be classified into two groups. The Hairy and Downy Woodpeckers foraged on trunks and branches. The Common Flicker foraged largely on the ground, but sometimes on trees. Red-breasted and White-breasted Nuthatches, Black-and-white Warblers and Black-capped Chickadees are all primarily bark gleaners. They infrequently attempt to drill. The Black-capped Chickadee and Red-breasted Nuthatch also forage in foliage.

The American Robin, Swainson's Thrush, and White-throated Sparrow foraged both on foliage and on the ground. The Rufous-sided Towhee, primarily a ground gleaner, occasionally gleaned insects from leaves and flowers.

The Yellow-rumped (Myrtle) Warbler, Dark-eyed Junco, and Field Sparrow exhibited different seasonal foraging interests. During the spring, the warblers tended to glean insects from leaves in the canopy but occasionally removed food from branches. Fall warblers also gleaned on the ground.

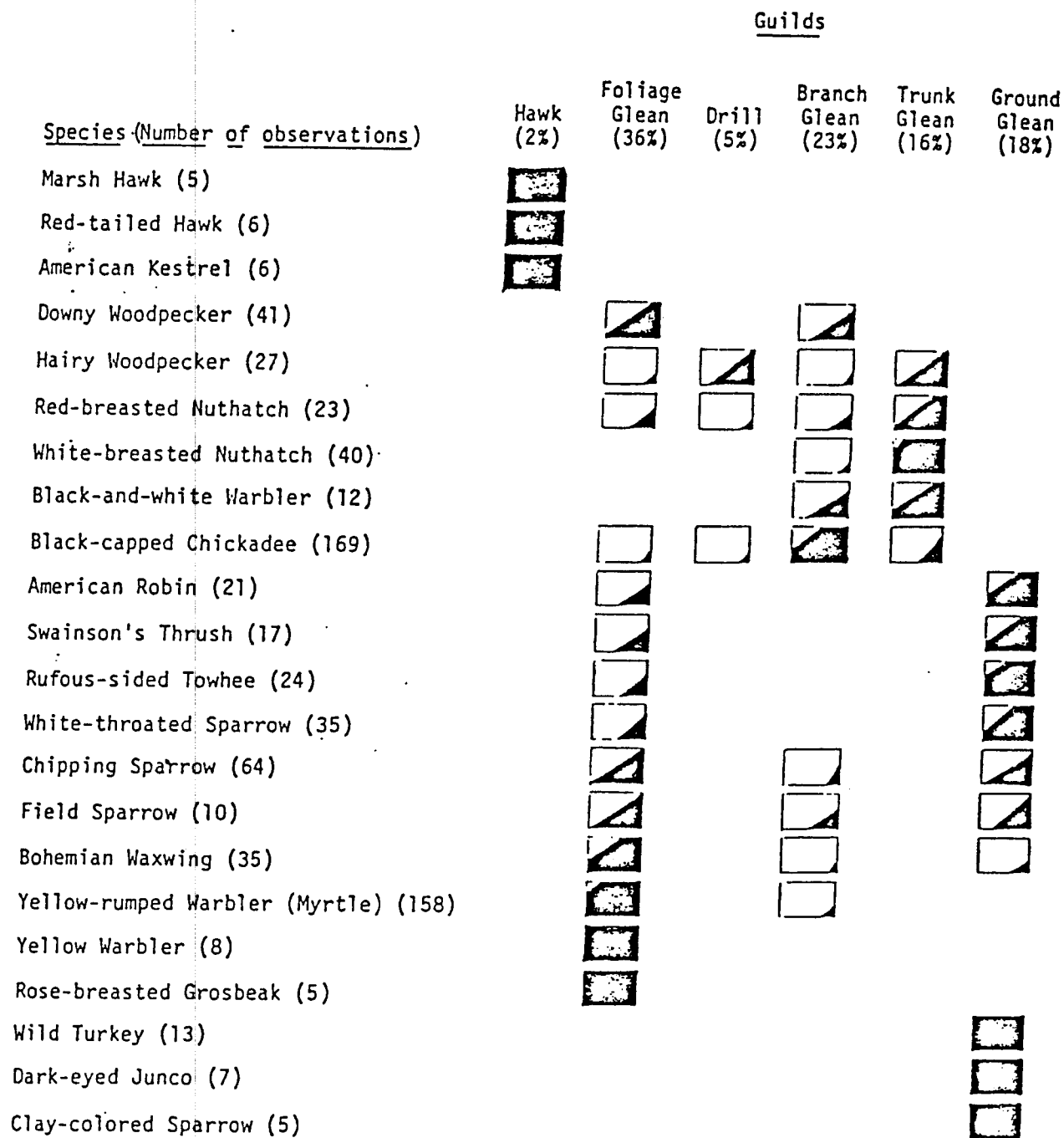


Figure 7. Avian guild specialization during spring migration. Amount of square filled indicates relative percentage of a particular guild used by a species.

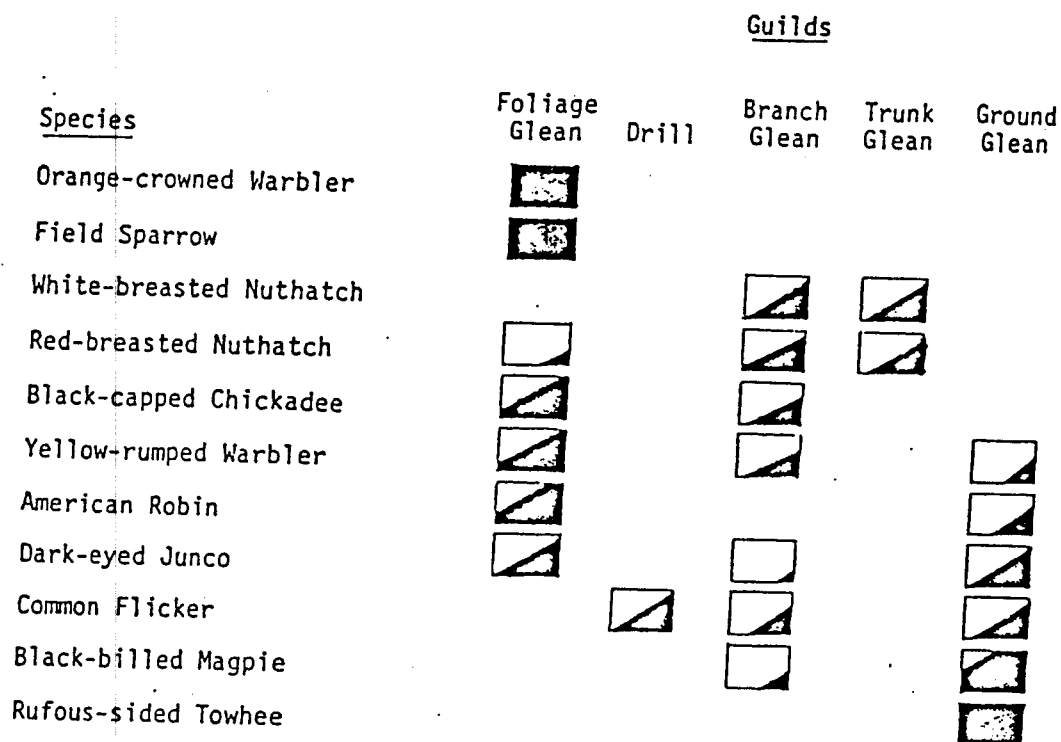


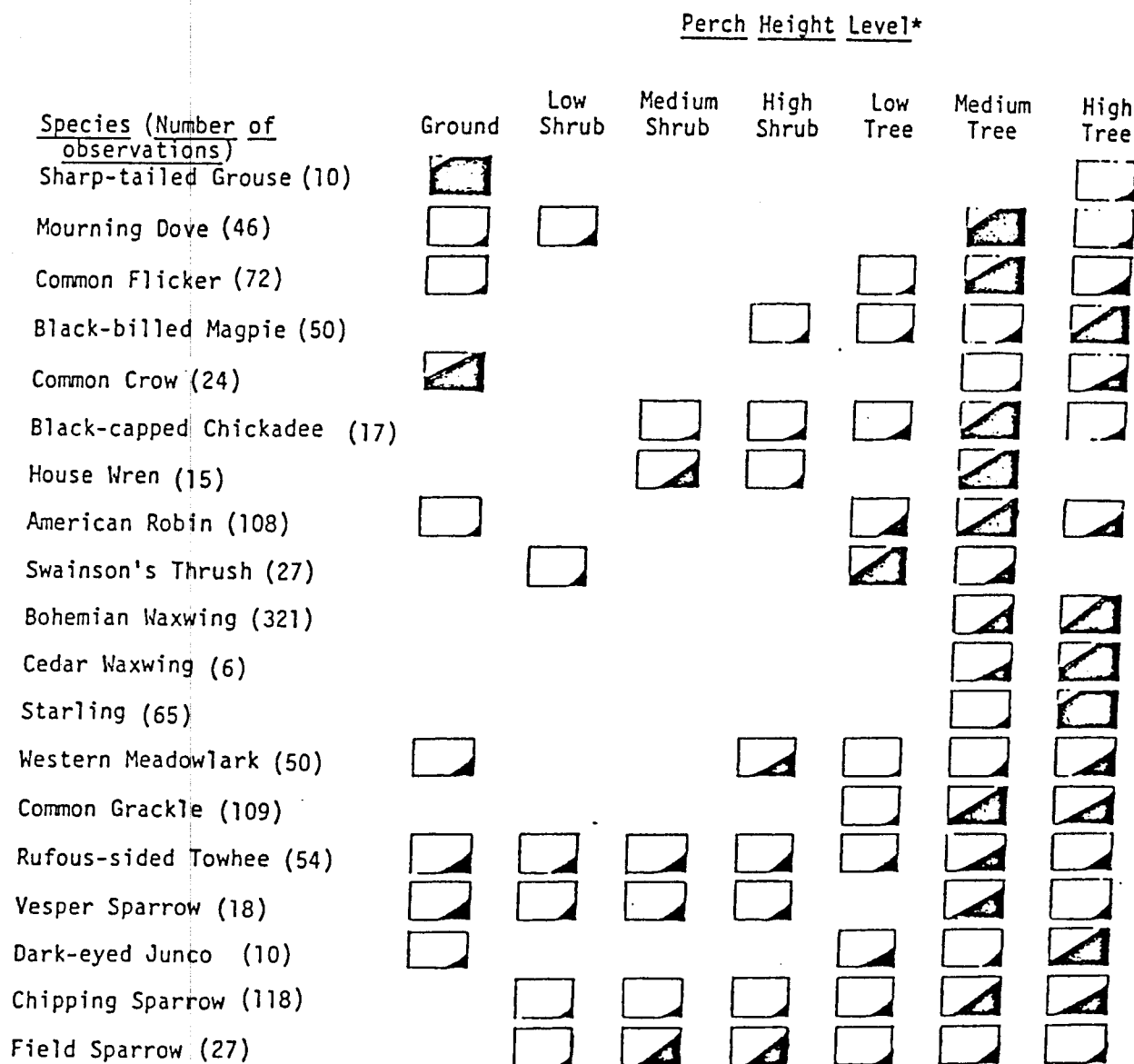
Figure 8. Avian guild specialization during fall migration. Amount of square filled indicates relative percentage of a particular guild used by a species.

Juncos also expanded their foraging tactics in the fall. The opposite was true for Field Sparrows. This tactical change may be related to the seasonal availability of food resources.

The Chipping Sparrow and Bohemian Waxwing acquire food by foliage, branch, and ground gleaning. The Clay-colored Sparrow and Wild Turkey were seen foraging on the ground, while the Yellow Warbler, Rose-breasted Grosbeak, and Orange-crowned Warbler gleaned foliage.

Perch Choice and Vocalization

Perch height levels and levels at which birds sang or called during spring migration are summarized in Figures 9 and 10. Some birds like the Blue Jay or House Wren were not seen foraging, while others like the White-crowned Sparrow were recorded only as foragers. This accounts for the variance in the species lists.



* See page 25 for explanation of height classification.

Figure 9. Observed perch height level used by birds during spring. Amount of the square filled indicates the relative percentage perching at any particular level.

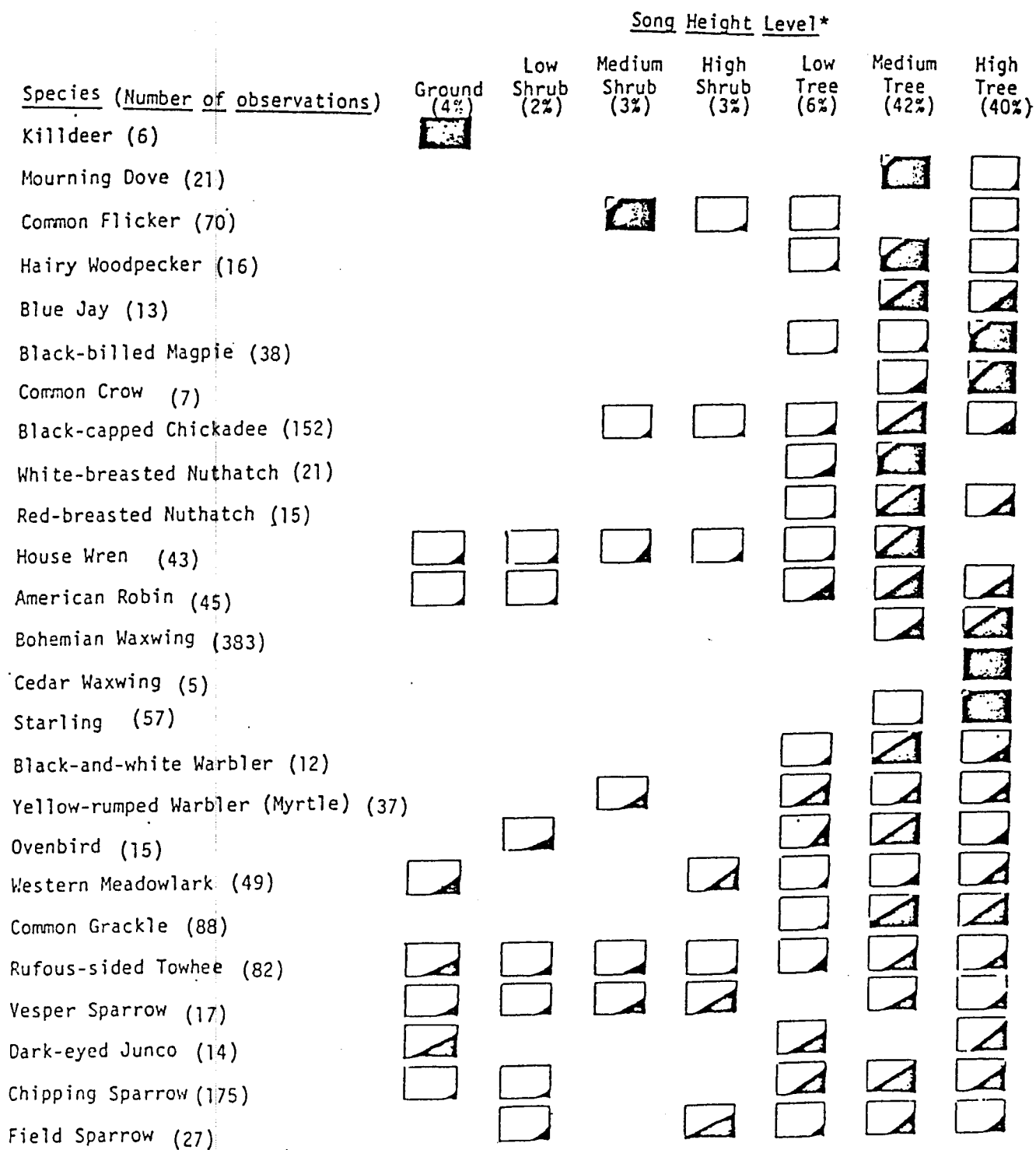


Figure 10. Observed height level used by birds singing or in spring. Amount of square filled indicates the relative percentage at any particular level.

Community Affinities

Some species utilized all or nearly all woodland habitats. Others were seen in only one habitat.

Generally Distributed Species

Five species occurred regularly in woodlands. Black-capped Chickadees and Chipping Sparrows were abundant on all areas. The Rufous-sided Towhee was seen infrequently on the juniper site, but was common elsewhere. American Robins were missed on the smaller pine site. Transient Myrtle Warblers were observed on all woodlands except the larger pine site and the juniper draws.

Cottonwood-Juniper Forest

Transient -- Myrtle Warblers were common to both sites. White-throated Sparrows occurred on the smaller area.

Breeding -- The American Kestrel, Mourning Dove, Common Flicker, House Wren, Rufous-sided Towhee, Chipping Sparrow, and Field Sparrow were common in both areas. The Red-tailed Hawk and Common Grackle were found only in the larger area. The many observations of Red-tailed Hawks during the spring were due to their early nesting on the site. Grackles were associated with thinly scattered cottonwoods adjacent to the prairie and an interstate highway right-of-way.

Resident -- The Hairy Woodpecker, Downy Woodpecker, Black-billed Magpie, Black-capped Chickadee, White-breasted Nuthatch, and American Robin were observed on both sites, although the magpies did not nest on the smaller site in 1980. Starlings, seen only on the larger site, occupied habitat similar to the grackles.

Winter visitant -- One flock of Bohemian Waxwings was observed on the larger area.

Mixed Hardwood Patches

Transient -- The Myrtle Warbler and Dark-eyed Junco utilized both sites.

Breeding -- Rufous-sided Towhees and Chipping Sparrows were frequently observed. The Common Flicker and Black-and-white Warbler were seen only in the ash-cottonwood area in the spring even though the warbler nested on the ash-elm site in June. The presence of flickers is influenced by cottonwoods and other high-canopy, snag-producing, deciduous trees. Field Sparrows, common on the ash-elm site, may be dependent on the nature of the woodland edge.

Resident -- The ash-elm site harbored Sharp-tailed Grouse, which characteristically breed in regions of mixed grass prairie and scattered tree-shrub margins (Stewart 1975). American Robins and Black-capped Chickadees were found on both sites.

Winter visitant -- Large flocks of Bohemian Waxwings utilized the ash-cottonwood area where they fed on the ground and on juniper berries.

Juniper Patches

Breeding -- The prairie associated with the juniper-mixed grass prairie site was important to the presence of Western Meadowlarks and Vesper Sparrows. Chipping Sparrows, Robins and Rufous-sided Towhees were found on both areas, but towhees were seen infrequently on the juniper site. Clay-colored Sparrows were uncommon on the juniper-mixed grass prairie site and did not nest. The lack of deciduous trees in the juniper areas probably accounts for Black-capped Chickadees being observed there only infrequently in the spring and fall, but not nesting.

Resident -- Black-billed Magpies utilized both sites.

Ponderosa Pine Forest

Transient -- The Swainson's Thrush was often observed on both sites. White-throated Sparrows frequented the shrubby areas on the large site. Fewer were seen on the other site. A large number of Myrtle Warblers were seen in the small pine area. Strangely, this form was not seen on the large site where the Audubon subspecies nested.

Breeding -- Chipping Sparrows and Rufous-sided Towhees were numerous on both sites, and Robins were seen in the deciduous patches. Black-and-white Warblers were more frequent on the large pine site.

Resident -- Black-capped Chickadees and Red-breasted Nuthatches were common on both sites. The Sharp-tailed Grouse and Turkey were found in the small pine area.

Grassland

Few birds utilized the prairie sites during migration. The Western Meadowlark, a breeding species, was common to both areas. North Dakota's most common grassland bird, the Horned Lark, was seen only on the smaller mixed grass site.

Notable Affinities

For those of us who enjoy nature, the presence of birds enhances the attractiveness and uniqueness of any habitat. That certain species of birds occur in some habitats and not in others indicates that birds also have preferences--factors contributed by a particular habitat. Such preferences are emphasized by several unique relationships observed during our investigation.

Three breeding species, the Mourning Dove, American Kestrel and House Wren, and three resident species, the Downy Woodpecker, Hairy Woodpecker and White-breasted Nuthatch, are characteristic of the cottonwood floodplain forest. Dark-eyed Juncos (transient) were found only in the mixed hardwood draws. Two species, the Swainson's Thrush (transient) and Red-breasted Nuthatch (resident), were found only in the Ponderosa pine forest. During spring and fall, at least, no species seems to particularly prefer either junipers or grassland over other available habitats.

Audubon's Warblers, which nest on both the Ponderosa pine sites, were seldom observed in the spring because most of them arrived after the migration study had ended. By this time, the Myrtle Warblers had departed. Hence, no intermingling of these two "field identifiable" subspecies of the Yellow-rumped Warbler was observed, nor were any intergrading characteristics noted on any individual.

The Roadside Counts

The 12 1/2 mile route traversed typical badlands terrain through numerous habitats. The counts provided a more extensive survey than the intensive plot counts. Table 13 summarizes observations during the spring of 1980.

The Gray Partridge, Northern Shrike, Bank Swallow and Barn Swallow were not seen on the study plots. The counts also provided a relative indication of the regularity and frequency of occurrence of those species whose behavior permits them to be observed by this method.

Breeding Birds

Habitat Affinities

Nesting birds are excellent indicators of habitat differences and change trends because of their abundance, observability, mobility, and preferences. Analysis of breeding bird communities produces critical information on the influence of various habitats on animal populations.

A few species are so specific in their preference that their presence indicates the existence of particular habitat characteristics. For example, the Yellow-headed Blackbird nests only in emergent vegetation. Although critical relationships may be less obvious in woodland breeders, the presence of an Ovenbird does indicate a mature woodland. Its absence, on the other hand, does not mean the woodland is immature nor that it lacks the specific habitat matrix which might support the species. The structure of the avian community and occurrence of certain groups of species indicates that a habitat is supplying their needs. Identifying differences in habitats by assessing differences in the composition of their avifauna aids in planning the types of habitats which should be maintained and developed to support the target species desired.

During the intensive study of the birds nesting on our target sites, 54 species were recorded. Six of the nine areas studied for three years showed breeding bird densities higher in 1980 than in 1979. Four areas had higher densities in 1981 than 1980 (Table 14). On four plots, the number of nesting species increased from 1979 to 1980. Only two plots had more species in 1981 than in 1980.

TABLE 14
Breeding Bird Census Summary, 1979 - 1981

Habitat Type	No. Species		Total Pairs		Pairs/Km ²		Pairs/100 Acres	
	1979	1980	1979	1980	1979	1980	1979	1980
Cottonwood Forests								
Cottonwood-Juniper I (47 A.)	28	29	127	131	668	674	270	274
Cottonwood-Juniper II (32 A.)	26	27	116	90	888	686	359	279
Mixed Hardwood Patches								
Ash-Cottonwood (7 A.)	9	11	26	33	868	1097	351	446
Ash-Elm (7 A.)	14	12	30	38	1023	1297	414	525
Juniper Patches								
Juniper (4 A.)	4	3	7	6	452	389	183	158
Juniper-Mixed Grass (6 A.)	6	4	12	8	467	308	189	125
Ponderosa Pine Forests								
Ponderosa Pine I (50 A.)	10	13	54	79	262	386	106	157
Ponderosa Pine II (10 A.)	3	5	6	11	148	271	60	110
Mixed Grass Rangeland								
Mixed Grass I (10 A.)	5	3	2	4	49	98	20	40
Mixed Grass II ^a (25 A.)	--	2	---	3	---	30	---	12

^aNot censused in 1979.

Cottonwood Forest

The cottonwood-juniper floodplain plots supported the greatest number of nesting species. In six surveys, the number of nesting species supported by these areas ranged between 24 and 29.

The density of nesting pairs in the cottonwood-juniper floodplain plots was greater than in the juniper draws and the pines, but less than in the upland ash draws. The total number of nesting pairs decreased on one site from 1979 to 1980 and increased on the other. In 1981, the number of nesting pairs decreased on one site while increasing on the other.

The most abundant species nesting in both cottonwood-juniper areas were the Mourning Dove, Common Flicker, House Wren, American Robin, Ovenbird, Rufous-sided Towhee and Chipping Sparrow. Table 15 lists all species occurring on these areas. The number of nesting species showed a slight decrease in 1981 from 1979 and 1980 in both of the cottonwood-juniper plots.

Several species in the cottonwood-juniper floodplain areas did not occur in the upland hardwoods, including the Red-headed Woodpecker, Hairy Woodpecker, Downy Woodpecker, Eastern Kingbird, Blue Jay, White-breasted Nuthatch, Warbling Vireo and Black-headed Grosbeak. According to Stewart (1975) these species prefer open moist woodland.

Mixed Hardwood Patches

The number of species nesting in the hardwood draws ranged between nine and 14 (six surveys). This is more species than were found in the juniper types. On the average, the ash-elm type supported slightly more nesting species than did the ash-cottonwood type. The number of species nesting in these upland hardwood draws was about half the number recorded

TABLE 15

Results Breeding Bird Census, 1979-1981

	Cottonwood Forests						Mixed Hardwood Patches						Juniper Patches						Pine Forest						Grassland					
	(47A)						Ash-Cottonwood (7A)						Juniper (4A)						(50A)						(10A)					
	79	80	81	79	80	81	79	80	81	79	80	81	79	80	81	79	80	81	79	80	81	79	80	81	79	80	81	79	80	81
Great Blue Heron	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mallard	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sharp-shinned Hawk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cooper's Hawk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Red-tailed Hawk	2	2	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Swainson's Hawk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Marsh Hawk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Merlin	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
American Kestrel	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sharp-tailed Grouse	+	6	6	-	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Ring-necked Pheasant	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gray Partridge	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Turkey	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Killdeer	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Long-billed Curlew	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Upland Sandpiper	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spotted Sandpiper	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mourning Dove	23	32	32	34	19	28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Black-billed Cuckoo	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Great Horned Owl	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Long-eared Owl	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Poor-will	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Common Nighthawk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Belted Kingfisher	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Common Flicker	15	17	21	16	25	19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Red-headed Woodpecker	2	2	10	6	6	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hairy Woodpecker	2	4	4	3	6	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Downy Woodpecker	2	4	4	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eastern Kingbird	9	11	17	12	9	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Western Kingbird	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Empidonax sp. Flycatcher	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Least Flycatcher	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Western Hood Pewee	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Horned Lark	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Barn Swallow	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Not censused in 1979

on the cottonwood-juniper floodplain areas. The total number of species in the upland draws was about the same as in the Ponderosa pine I site (Table 14).

Of all the plots censused 1979-1981, the ash-elm type had the highest density of nesting pairs. The ash-cottonwood type had the next greatest density of pairs for all years. The number of nesting pairs increased on both these areas from 1979 to 1980, but increased on only one area from 1980 to 1981.

The most abundant nesting species in both draws were Rufous-sided Towhees, Chipping Sparrows and Red-eyed Vireos. Black-and-white Warblers were more abundant in 1980 and 1981 than in 1979. Lazuli Buntings showed a substantial decrease in nesting densities from 1979 to 1980, but increased again in 1981. Several other species either nested in only one plot or were not abundant (Table 15). No species was restricted to the upland draws, although the Rufous-sided Towhee, American Redstart and Lazuli Bunting seemed to be more frequent in this habitat than elsewhere.

Juniper Patches

Of the wooded areas, the juniper draws supported the lowest number of nesting species, ranging between three and six (six surveys). The number of species decreased in both juniper areas from 1979 to 1980, but increased slightly or remained the same from 1980 to 1981.

The density of nesting pairs on these areas was less than in the hardwood areas (Table 14). Densities were more nearly comparable to those in the Ponderosa pine type. The density of pairs decreased in both plots from 1980 to 1981. In 1979 the nesting densities were nearly the same in the two areas. In 1980 and 1981 the juniper type supported more pairs than the juniper-mixed grass type.

Cliff Swallow	2	2	3	6	6	3	22	27	49	14	29	14	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	29	14	2
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The density of nesting pairs in the Ponderosa pine plots was lower than in the ash draws and cottonwood-juniper floodplain plots but greater than in the juniper type. The density of nesting pairs increased on both areas from 1979 to 1980, and decreased slightly on the larger area and increased on the smaller area in 1981.

The most abundant nesting species found in both the Ponderosa pine plots were the Chipping Sparrow and Rufous-sided Towhee. The density of both species increased from 1979 to 1980. In 1981 Rufous-sided Towhees decreased in number on both plots, while Chipping Sparrows showed increases on both plots. Several other species nested only on the larger plot. These included the Marsh Hawk, American Kestrel, Red-breasted Nuthatch, House Wren, Red-eyed Vireo and Common Yellowthroat.

Two species nesting only in Ponderosa pine areas were the Audubon's Warbler and Red-breasted Nuthatch. The Ponderosa pine forest in Slope Co. is the only area in North Dakota where these species are known to nest (Kroodsmas and Cassel 1968). In the large Ponderosa pine plot, Audubon's Warbler nested all three years, with densities about the same. This warbler nested in the small plot only in 1980 and 1981. In 1979, however, at least one territory was just east of the delineated smaller area. The Red-breasted Nuthatch nested on the larger plot in 1980 and 1981, but was recorded on the small plot only in 1981.

Mixed-Grass Rangeland

The prairie plots supported both the lowest number of species and lowest densities of nesting pairs. The most common nesting species was the Western Meadowlark. Other nesting species on the smaller mixed-grass prairie plot were the Mourning Dove and Vesper Sparrow. Censused only in

The most frequent nesting species in both plots were Rufous-sided Towhees, Chipping Sparrows and Black-billed Magpies. In 1980, Rufous-sided Towhees decreased in both juniper draws. In 1981, Rufous-sided Towhees increased in the juniper-mixed grass plot, but decreased slightly in the juniper plot. In 1980, Chipping Sparrows decreased in the juniper-mixed grass draw but remained about the same in the juniper area. Chipping Sparrows increased on both plots in 1981. The Black-billed Magpie did not nest in the juniper-mixed grass draw in 1979 but nested there in 1980. In the juniper draw, Black-billed Magpies nested all three years, with the density higher in 1980 than the other two years.

The Chipping Sparrow is widely distributed in the pinyon-juniper habitats of the southwestern United States. It is particularly adept at locating its nest on branches of junipers (Laudenslayer and Balda 1976). Both our investigation and that of Hopkins (1980) showed Chipping Sparrows to be abundant in the juniper woodlands of the North Dakota Badlands.

Ponderosa Pine Forest

The number of species nesting in the large (50 A) area of Ponderosa pine was greater than in the juniper draws but less than in cottonwood-juniper floodplain areas. The number of nesting species was similar to that of the ash draws. The small (10 A) plot of Ponderosa pine had fewer nesting species than the large plot. The difference in number of nesting species may be related to plot size (Galli et al. 1976). The number of nesting species on both areas increased from 1979 to 1980, but decreased on the larger plot and increased on the smaller plot in 1981.

TABLE 16
Breeding Bird Diversity Indices

Habitat Type	Species Diversity Index (SDI)			Average SDI	
	1979	1980	1981		
Cottonwood Forests					
Cottonwood-Juniper I	2.59	2.91	2.82	2.77	2.79
Cottonwood-Juniper II	2.77	2.89	2.77	2.81	
Mixed Hardwood Patches					
Ash-Cottonwood	2.00	2.22	2.16	2.12	2.10
Ash-Elm	2.37	1.98	1.93	2.09	
Juniper Patches					
Juniper	1.15	1.01	1.25	1.13	1.16
Juniper-Mixed Grass	1.13	1.32	1.15	1.20	
Ponderosa Pine Forests					
Ponderosa Pine I	1.84	2.10	1.96	1.96	1.59
Ponderosa Pine II	.68	1.36	1.64	1.22	
Mixed Grass Rangeland					
Mixed Grass I	.69	1.03	.63	.78	.68
Mixed Grass II ^a	--	.63	.56	.59	

^aNot censused in 1979.

1980 and 1981, the larger mixed-grass plot supported the Western Meadowlark, Brewer's Blackbird and Vesper Sparrow.

Visitors observed during the breeding seasons are summarized in Table 15.

Diversity

The diversity and physical structure of the plant species are important factors in determining avian diversity. MacArthur and MacArthur (1961), Karr (1968), Karr and Roth (1971), and Willson (1974) found that breeding bird diversity is related to the number of foliage layers present. Bird species diversity has also been shown to increase as succession progresses. The increase in bird species diversity as a plant community ages is most likely related to the increased complexity of the community. The Shannon-Wiener Function (page 25) was used to calculate the diversity of each breeding bird community.

For the three seasons of study, bird species diversity was lowest in the mixed-grass prairies and juniper draws and higher in the Ponderosa pine and upland ash sites. Species diversity was highest all years in the cottonwood-juniper floodplain areas (Table 16). Hiemenz and Cassel (1980) and Hopkins (1980), studying other avian communities in the North Dakota Badlands, found that bird species diversity was significantly correlated with the diversity of vertical foliage layering and total percent of vegetation cover. The higher indices of bird species diversity in the cottonwood-juniper floodplain stands and upland ash draws reflect the greater habitat complexity in these woody areas.

TABLE 17

Foraging Affinities of Breeding Birds^a

GROUND GLEANING	FOLIAGE GLEANING	SALLYING	BARK FEEDING	GENERALISTS (Omnivores)	RAPTORS
Ground Seed Foraging		Air Insect Foraging	Drilling	Blue Jay	Cooper's Hawk
Ring-necked Pheasant	Foliage Insect Foraging	Common Nighthawk	Hairy Woodpecker	Western Meadowlark	Red-tailed Hawk
Turkey	Black-billed Cuckoo	Eastern Kingbird	Downy Woodpecker	Brown-headed Cowbird	Marsh Hawk
Mourning Dove	House Wren	Mountain Bluebird	Red-headed Woodpecker	Lark Sparrow	Great Horned Owl
Common Crow	Gray Catbird	American Redstart	Bark Gleaning		Long-eared Owl
Lazuli Bunting	Red-eyed Vireo		White-breasted Nuthatch		
American Goldfinch	Warbling Vireo		Red-breasted Nuthatch		
Rufous-sided Towhee	Yellow Warbler		Black and White Warbler		
Ground Insect Foraging	Yellow-rumped Warbler				
American Kestrel	Common Yellowthroat				
Killdeer	Yellow-breasted Chat				
Common Flicker	Orchard Oriole				
Black-billed Magpie	Northern Oriole-Baltimore				
Brown Thrasher	Northern Oriole-Bullock's				
American Robin	Black-headed Grosbeak				
Starling	Vesper Sparrow				
Ovenbird	Field Sparrow				
Brewer's Blackbird					
Common Grackle					
Chipping Sparrow					

^aData on foraging guilds are from Salt (1953), Root (1967), Martin, Zim, and Nelson (1951).

Foraging Guilds -- Habitat Preference

The ecological affinities of the species nesting on the study areas from 1979 to 1981 are shown in Table 17. Willson (1974) determined that the addition of species along a gradient of habitat complexity is primarily a function of the addition of guilds. The changes in species composition and growth form of plants along a height gradient provides differing foraging opportunities that ultimately determines how many bird species can occupy that environment (Holmes et al. 1979).

Four foraging guilds utilized the prairies during the breeding season: ground seed, ground insect, foliage insect, and omnivore. Only the ground insect guild was represented by more than one species. The ground seed foragers utilized only one prairie plot.

In the wooded areas, the addition of guilds is apparently influenced by habitat complexity. While five guilds utilized the juniper patches, six used some parts of the Ponderosa pine forest, seven the mixed hardwood patches and eight the cottonwood-juniper forests. Not all guilds utilizing a habitat type are always represented on a specific site. The number of guilds as well as the number of species in each seems to be greatest in mature deciduous forests that have a well-developed canopy and a dense understory (Table 18).

Ground Gleaning Guilds

Ground Seed Foraging

Ground seed foraging species in the woodlands varied in number from two in the juniper patches to seven in one cottonwood forest (13-40% of the species making up the communities). The most abundant ground seed foragers were the Mourning Dove and Rufous-sided Towhee. Towhees were abundant in all areas while Mourning Doves were more common in the cottonwood forests.

Ground Insect Foraging

Ten ground insect foraging species utilized cottonwood forests while only one the ash-elm draw. Proportions of the total avian community species ranged from 6% to 40%. Ground insect foragers occurred in all areas. The most abundant ground insect forager, the Chipping Sparrow, inhabited all plots. Other common ground foragers were the Ovenbird, Common Flicker and American Robin. Ovenbirds were most frequent in areas of deciduous trees, but densities were also fairly high in the larger Ponderosa pine area. Robins were recorded only in the ash-cottonwood draw and cottonwood-juniper floodplain areas. Flickers were most common in the ash-cottonwood draw and cottonwood-juniper floodplain areas. The well-developed shrub and herbaceous strata in the deciduous areas may harbor more invertebrates, thereby accounting for the abundance of ground insect foragers in those areas. The understory in the juniper draws and Ponderosa pine areas was relatively sparse.

Foliage Gleaning - Insect Foraging

Foliage insect foraging species did not use the juniper draw while 9 (26%) and 12 (32%) fed in the cottonwood-juniper floodplain areas. A relatively high proportion of the species in the Ponderosa pine areas were foliage insect foragers. The most common species in this guild in the deciduous plots were the Black-capped Chickadee, House Wren, Red-eyed Vireo and Warbling Vireo, which find these areas favorable because of the well-developed overstory canopies. In the Ponderosa pine areas, the most common foliage insect foragers were the Black-capped Chickadee, Audubon's Warbler and Common Yellowthroat. Common Yellowthroats were usually seen in shrubs near the edge of small hardwood patches within the pine sites,

TABLE 18
Number and Proportion (%) of Species in Foraging Guilds

	Cottonwood-Juniper I	Cottonwood-Juniper II	Ash-Cottonwood	Ash-Elm	Juniper	Juniper-Mixed Grass	Ponderosa Pine I	Ponderosa Pine II	Mixed Grass I	Mixed Grass II
GROUND GLEANING										
Ground Seed Foraging	5 (13)	7 (20)	4 (29)	5 (28)	2 (40)	2 (29)	4 (25)	3 (33)	1 (20)	---
Ground Insect Foraging	10 (26)	9 (26)	4 (29)	1 (6)	2 (40)	3 (43)	4 (25)	2 (22)	2 (40)	1 (33)
FOLIAGE GLEANING										
Foliage Insect Foraging	12 (32)	9 (26)	3 (21)	6 (33)	---	1 (14)	5 (31)	2 (22)	1 (20)	1 (33)
SALLYING										
Air Insect Foraging	1 (3)	2 (5)	2 (14)	1 (6)	---	---	---	1 (11)	---	---
BARK FEEDING										
Drilling	3 (8)	3 (9)	---	---	---	---	---	---	---	---
Bark Gleaning	2 (5)	2 (5)	1 (7)	1 (6)	1 (20)	---	---	1 (11)	---	---
GENERALISTS (Omnivorous)	3 (8)	2 (5)	---	2 (11)	---	1 (14)	---	---	1 (20)	1 (33)
RAPTORS	2 (5)	1 (3)	---	2 (11)	---	---	1 (6)	---	---	---
TOTALS	38 (100)	35 (99)	14 (99)	18 (101)	5 (100)	7 (100)	16 (100)	9 (99)	5 (100)	3 (99)

upland ash draws, while both Black-and-white Warblers and White-breasted Nuthatches were recorded in the cottonwood-juniper floodplain sites. Red-breasted Nuthatches and Black-and-white Warblers were found in the Ponderosa pine stands. Bark feeding birds were not abundant on any of the areas. The number of Black-and-white Warblers in the two upland ash draws increased in density from 1979 to 1980, and decreased on one plot while increasing on the other in 1981.

Generalists

General feeders (omnivores) were recorded in all woodland types except the pines and included the Blue Jay, Western Meadowlark, Brown-headed Cowbird and Lark Sparrow. The relative proportions ranged from 5% to 14% of the species in these communities. The Blue Jay and Brown-headed Cowbird were only recorded in the floodplain forests and ash-elm plot, and were not abundant. The Western Meadowlark nested in the larger cottonwood-juniper plot in 1979. The Lark Sparrow fed in the mixed hardwood patches.

Raptors

Hawks and owls nested in the deciduous tracts. The Red-tailed Hawk and Great Horned Owl showed a preference for the cottonwood-juniper floodplain sites. The Cooper's Hawk nested in the ash-elm draw in 1979 and 1981, and the Long-eared Owl nested there in 1979. In 1979 a Marsh Hawk nested in a buck-brush patch on the larger Ponderosa pine area. (Golden Eagles nested on the large Ponderosa site in 1975.)

while Black-capped Chickadees and Audubon's Warbler often were seen foraging in the pine canopy.

Sallying - Insect Foraging

Air insect foraging species were recorded only in the stands dominated by deciduous trees. The number of species in this category varied from one to three (3 to 14%). The only species in this category were the Eastern Kingbird, American Redstart and Mountain Bluebird. Eastern Kingbirds were recorded only on the cottonwood-juniper floodplain areas. American Redstarts were recorded on all the deciduous areas except one cottonwood-juniper floodplain site. Nesting densities of American Redstarts tended to be higher in the upland deciduous draws. The Mountain Bluebird was recorded only in the ash-cottonwood plot in 1981. This species was often seen flying from the forest edge to capture insects over the adjacent prairie. Flying insects seemed more common in the deciduous tracts. The dispersion of the trees also provided more foraging space.

Bark Feeding Guilds

Drilling

Drilling species in this study included the Hairy, Downy and Red-headed Woodpeckers. These species, uncommon in all years, were recorded only in the cottonwood-juniper floodplain sites. They were not abundant in any year. The presence of these species on the cottonwood areas may be due to the larger, easily explored tree trunks and favorable snag quality.

Bark Gleaning

Bark searching birds included the White-breasted and Red-breasted Nuthatches and Black-and-white Warbler. These species utilized most of the areas studied. Only Black-and-white Warblers were recorded in the

Guild Variety

An increasing variety of guilds and species in woody areas appears to be related to the continuing development of the shrub stratum and upper-tree canopy. In the Ponderosa pine and upland ash draws the understory is sparse because of grazing by livestock. On the other hand, the cottonwood-juniper floodplain sites, where no cattle grazed, are much more diverse, being characterized by a well-developed canopy and shrub stratum as well as good ground cover. These areas tended to support a more varied avifauna.

Nesting Guilds

Comparing the microhabitats where birds place their nests provides clues as to how breeding species interact with the vegetation structure (Table 19). Four guilds were observed: ground nesters, shrub-sapling nesters, tree canopy nesters and cavity nesters. Preferences for nest sites were determined by the relative proportion of species in the different nesting guilds in the various habitats (Table 20).

Ground

The most common and abundant ground nester found in the study areas was the Rufous-sided Towhee. Another ground nester fairly common in the deciduous tracts and larger Ponderosa pine area was the Ovenbird. Both the Rufous-sided Towhee and Ovenbird were found where the understory shrubbery was well developed. The brushy edges and patches found around and throughout the woodlands were preferred by singing territorial males. The deciduous tracts and larger Ponderosa pine area supported high densities of ground nesting species. Most species nesting on the prairies were ground nesters, the Western Meadowlark being most common.

TABLE 19
Nesting Affinities of Breeding Birds^a

GROUND	SHRUB-SAPLING	TREE CANOPY	CAVITY
Ring-necked Pheasant	Marsh Hawk	Cooper's Hawk	American Kestrel
Turkey	Black-billed Cuckoo	Red-tailed Hawk	Common Flicker
Killdeer	Gray Catbird	Mourning Dove	Hairy Woodpecker
Common Nighthawk	Brown Thrasher	Great Horned Owl	Downy Woodpecker
Black and White Warbler	Yellow Warbler	Long-eared Owl	Red-headed Woodpecker
Ovenbird	Common Yellowthroat	Eastern Kingbird	Black-capped Chickadee
Western Meadowlark	Yellow-breasted Chat	Blue Jay	White-breasted Nuthatch
Brewer's Blackbird	American Redstart	Black-billed Magpie	Red-breasted Nuthatch
Rufous-sided Towhee	Lazuli Bunting	Common Crow	House Wren
Vesper Sparrow	American Goldfinch	American Robin	Mountain Bluebird
Lark Sparrow	Chipping Sparrow	Starling	
	Field Sparrow	Red-eyed Vireo	
		Warbling Vireo	
		Yellow-rumped Warbler	
		Orchard Oriole	
		Northern Oriole - Baltimore	
		Northern Oriole - Bullock's	
		Common Grackle	
		Brown-headed Cowbird	
		Black-headed Grosbeak	

^aData on nesting guilds are from Roberts (1936), Stewart (1975), and Udvardy (1979).

TABLE 20
Number and Proportions (%) of Species in Nesting Guilds

Nest Site	Habitat Type									
	Cottonwood-Juniper I	Cottonwood-Juniper II	Ash-Cottonwood	Ash-Elm	Juniper	Juniper-Mixed Grass	Ponderosa Pine I	Ponderosa Pine II	Mixed Grass I	Mixed Grass II
Ground	6 (16)	6 (17)	4 (29)	5 (28)	2 (40)	3 (43)	5 (31)	5 (56)	4 (80)	3 (100)
Shrub-Sapling	9 (24)	8 (23)	3 (21)	6 (33)	1 (20)	2 (29)	4 (25)	1 (11)	1 (20)	---
Tree Canopy	15 (39)	13 (37)	3 (21)	5 (28)	2 (40)	2 (29)	3 (19)	2 (22)	---	---
Cavity	8 (21)	8 (23)	4 (29)	2 (11)	---	---	4 (25)	1 (11)	---	---
TOTAL SPECIES	38 (100)	35 (100)	14 (100)	18 (100)	5 (100)	7 (101)	16 (100)	9 (100)	5 (100)	3 (100)

Shrub-Sapling

Shrub-sapling nesters were most common where the shrub understory was well developed. The understory was relatively sparse in the Ponderosa pine, juniper and upland ash draws. The most common and abundant shrub-sapling nester found in all areas was the Chipping Sparrow. Other abundant shrub-sapling nesters in the deciduous tracts were the American Redstart, Common Yellowthroat and Lazuli Bunting.

Tree Canopy

A high percentage of the avian community in the cottonwood-juniper type nested in the canopy. Canopy nesters in the juniper draws were the Black-billed Magpie and Mourning Dove. In the Ponderosa pine areas, the Audubon's Warbler and Mourning Dove were the most common canopy nesters. In the deciduous tracts, several canopy nesters including the Mourning Dove, American Robin, Red-eyed Vireo, Eastern Kingbird, Warbling Vireo and Black-headed Grosbeak were abundant. While Mourning Doves, Eastern Kingbirds and Robins typically place their nests along the main trunk of a tree, those found were usually closer to the outer portions of the canopy. The number of canopy nesting species in the cottonwood-juniper areas was three times greater than in the ash draws.

Cavity

In the large Ponderosa pine area the dispersion of Red-breasted Nuthatches coincided with known pine snags. No pine snags occurred in the smaller pine area. The Black-capped Chickadee and American Kestrel were associated with the hardwoods growing in the drainage courses in the pines.

The number of cavity nesting species in the cottonwood-juniper flood-plain areas was up to four times greater than in the upland ash draws. The

only cavity nesters recorded in the upland ash draws were the Black-capped Chickadee, House Wren and Common Flicker. Of the eight cavity nesting species in the cottonwood-juniper floodplain area, the most abundant were the Common Flicker and House Wren. Other cavity nesters in these floodplain sites included the American Kestrel, Red-headed Woodpecker, Hairy Woodpecker, Downy Woodpecker, Black-capped Chickadee and White-breasted Nuthatch. The abundance of cavity nesters reflects the abundance of suitable snags for nesting. No cavities were found in the juniper woodlands.

The greatest variety of species in the wooded areas occurs where a well-developed tree canopy and numerous snags are present. These conditions are important to the maintenance of a dense and diverse avifauna.

Comparison of Ungrazed and Grazed Mixed Hardwood Patches

In 1979 six upland ash draws were studied (Hiemenz and Cassel 1980, Hopkins 1980) in projects supported by the Bureau of Land Management (BLM), the Forest Service (USFS) and the National Park Service (NPS). The BLM and USFS areas were also studied in 1980 and the USFS areas in 1981. Two 15 A. plots, located in Billings County in the Theodore Roosevelt National Park 7-10 miles north of Medora, were lightly grazed by free-ranging bison. One, a 12 A. riverine patch in Golden Valley County, 12 miles north of Beach, was heavily grazed by cattle in the winter only. Another, a 13 A. patch on the slopes of a ravine six miles north of Fairfield in Billings County, was moderately grazed. The other two, 7 A. plots about 10 miles south of Medora in Billings County (discussed in this report), were heavily grazed throughout the year.

The number of nesting species (Table 21) was more similar in the moderately grazed sites and the sites lightly grazed by bison. The number

TABLE 21

Breeding Pairs/100 A. of Mixed Hardwood Patches
Subject to Differing Intensities of Grazing

Species	Habitat Plots											
	BLM ^a				USFS ^b				NPS ^c			
	Ash-Box Elder (Winter pasture only)		Ash-Elm (Moderately grazed)		Ash-Elm (Heavily grazed)			Ash-Cottonwood (Heavily grazed)		Ash (Lightly grazed bison only)	Ash-Box Elder (Lightly grazed bison only)	
	1979	1980	1979	1980	1979	1980	1981	1979	1980	1981	1979	1980
Ring-necked Pheasant		8										
Mourning Dove	33	42	67	44					41		7	14
Turkey						14				14		
Cooper's Hawk					14		14				7	
Black-billed Cuckoo	25	8	30	7								
Long-eared Owl					14							
Common Flicker		8	15					14	27		13	7
Eastern Kingbird	8	8	15	7								14
Least Flycatcher	8		15	22								
Common Crow					14							
Black-capped Chickadee		8		7	14	14	29		14	29	33	21
White-breasted Nuthatch											7	7
House Wren	67	108	111	59	49			27				
Gray Catbird	50	67	44	44							7	
Brown Thrasher	8	25	15	30							7	7
American Robin	17	17	15	22				14	27	57	7	14
Mountain Bluebird										14		
Veery											7	
Bell's Vireo				7								
Red-eyed Vireo		8	22	15	42	42	43	41	27	57	40	36
Black-and-white Warbler				7	14	42	29	14	41	57	26	7
Yellow Warbler	58	125	59	82								14
Ovenbird				7				54	68	29	40	14
Common Yellowthroat	58	25	15	22							13	7
Yellow-breasted Chat				7	28						7	14
American Redstart			7		14	28			41		26	14
Red-winged Blackbird	17	8										
Orchard Oriole											7	
Brown-headed Cowbird	25	42	22	37			14					
Black-headed Grosbeak		8		15								
American Goldfinch	17	25	22	22		14	14				7	7
Rufous-sided Towhee	25	50	52	67	112	224	200	95	108	57	20	50
Lark Sparrow		12			14	28	14					
Clay-colored Sparrow		8										7
Field Sparrow			+	15	28	35	21					7
Chipping Sparrow		8			28	56	71	54	41	86		7
Lazuli Bunting					28	14	57	41	14	57		
Vesper Sparrow						14						
Song Sparrow												14
Totals												
No. Species	14	21	17	21	14	12	11	9	11	10	19	21
Pairs/100 acres (40 ha)	417	621	533	548	413	525	506	354	449	457	320	310

^aHiemenz and Cassel (1980)^cHopkins (1980)^bThis study.

of species was not significantly lower in the heavily grazed areas ($p > .05$), nor were the densities of nesting pairs significantly lower in the moderately grazed and heavily grazed areas than in the areas which were lightly grazed by bison ($p > .05$).

While the number of nesting species and densities of nesting pairs did not vary significantly between the sites, the composition of the breeding birds was noticeably different. A striking difference in the breeding birds of these areas was the presence of high densities of Black-billed Cuckoos, Least Flycatchers, House Wrens, Gray Catbirds, Brown Thrashers and Yellow Warblers in only the moderately and winter-grazed areas. Some of the abundant species common to most of the areas included the Black-capped Chickadee, American Robin, Red-eyed Vireo, Black-and-white Warbler and Rufous-sided Towhee. The differences in avifaunal composition which do not reflect changes in grazing pressure indicate that these birds may be responding to habitat factors other than grazing.

Dambach and Good (1940) record bird diversity in protected (ungrazed) woods as twice that of grazed woods. Weatherkill and Keith (1969) found that the number of White-throated Sparrows, Ovenbirds, Least Flycatchers and Red-eyed Vireos was not affected by either light or moderate grazing in aspen forests. The similarity in the number of nesting species recorded in our more lightly grazed sites indicates a similar response. Although the number of species an area can support may be reduced by heavy grazing pressure, the overall density of pairs may not be reduced. The density of nesting pairs may not be affected to a great extent because grazing may alter the habitat and make it more attractive for some species.

Due to the drought of 1980, greater than average grazing pressure occurred in woody areas as cattle moved in from the parched prairies. Heavy use of the undergrowth was noted on some sites.

Follow-up studies in the spring of 1981 did not show any definite trends in the two heavily grazed ash draws investigated. Although the number of nesting species decreased slightly from 1980, the densities of nesting pairs either increased or decreased only slightly. Rufous-sided Towhees, the most abundant ground nester in these plots, decreased in densities in 1981 over 1980. This may reflect disturbance of the understory shrubbery with which the Rufous-sided Towhee is often associated. The increases and decreases in nesting densities of other species, however, showed little discernable influence of grazing on the avian communities in these woodlands. More careful assessment of the impact of grazing on woodland bird communities, if any, must await carefully designed controlled experiments over a much longer time than was possible in this investigation.

TREES DO INFLUENCE BIRDS

The increasing density and geographic expansion of human populations is accompanied by accelerated development and use of natural resources. Effective conservation is necessary to maintain a healthy and balanced environment. Environmental management decisions should be based on data. Short-term studies give little insight as to trends. The need continues for long-range comparative investigations of wildlife habitats.

Tables and figures in this report have summarized specific facets of our three-year investigation. What is the role of the natural wooded areas in southwestern North Dakota in the life of birds?

The few natural woodlands in western North Dakota are scattered on slopes and along drainage courses in isolated patches, appearing as islands in a sea of grass. Natural woodlands are particularly important to the survival of many plant and animal species. Many vertebrates occur only in these wooded areas. Current interest in island biogeography gives these areas particular theoretical importance.

1. Of the 16 species observed in winter, 14 utilize the areas all year, one was accidental, and the other nests to the north. The role of woody cover in protecting wintering birds is important. Especially important are "snags." Dead trees provide holes for winter roosting. In North Dakota, hole-utilizing birds such as the Downy and Hairy Woodpeckers, Black-capped Chickadee, and White-breasted Nuthatch form a major component of winter bird communities.
2. Individuals of many migrating species stayed to nest in the Badlands area. Other species were seen only as they passed through. These "transients" included two thrushes, two vireos, seven warblers, and seven sparrows. Of these 18 species, eight foraged mainly in the tree canopy, while five others sometimes gleaned in the canopy. Ten gleaned on the ground. Transient species restricted to woodlands included:

Wooded Habitats (deciduous and evergreen)

Swainson's Thrush
 Tennessee Warbler
 Blackpoll Warbler
 Orange-crowned Warbler
 Lincoln's Sparrow
 Tree Sparrow
 Dark-eyed Junco
 White-throated Sparrow

Cottonwood Forest

Solitary Vireo
Nashville Warbler

Mixed Hardwood Patches

Philadelphia Vireo
Harris' Sparrow
White-crowned Sparrow

Juniper Patches

No transients showed a distinct preference for this type.

Ponderosa Pine Forest

Gray-checked Thrush
Palm Warbler
Mourning Warbler
Canada Warbler
Fox Sparrow

3. Of the 22 most common "migrants" seen in the spring, only three may sometimes be found in unforested areas. The total number of migrants recorded in five habitat types were:

<u>Habitat Type</u>	<u>Species Richness</u>
Cottonwood Forest	55
Mixed Hardwood Patches	45
Juniper Patches	23
Ponderosa Pine Forest	36
Prairie	18

4. In 1979 to 1981 we recorded 54 breeding species. Thirty-nine of these were found only in woodlands and not in adjacent grasslands or wetlands. Most of the birds were recorded are "on territory." This is probably the most critical time in a bird's life. The choice of song perches, nesting places, and feeding sites usually are vegetation related. Hence, species found in only one habitat type during this period can be considered as dependent on that type.

Others, not specific to only one type, may depend upon similar conditions in two or more types. Our records show:

Species restricted to Type

16	Woodlands (in general)
6	Deciduous Habitats
12	Cottonwood Forests
3	Mixed Hardwood Patches
2	<u>Ponderosa Pine Forest</u>
39	Natural Woodlands

5. Many nesting species were found in a particular woody type. The species-habitat type affinities are:

Wooded Habitats (including both deciduous and evergreen type habitats)

American Kestrel	American Robin
Ring-necked Pheasant	Red-eyed Vireo
Turkey	Black-and-white Warbler
Black-billed Cuckoo	Yellow Warbler
Great Horned Owl	Ovenbird
Common Nighthawk	Common Yellowthroat
Common Flicker	Rufous-sided Towhee
Black-capped Chickadee	Chipping Sparrow

Deciduous Habitats (both cottonwood forests and mixed upland patches)

House Wren	Common Grackle
Gray Catbird	Yellow-breasted Chat
Brown Thrasher	American Redstart

Cottonwood Forests

Red-tailed Hawk	White-breasted Nuthatch
Red-headed Woodpecker	Starling
Hairy Woodpecker	Warbling Vireo
Downy Woodpecker	Orchard Oriole
Eastern Kingbird	Northern Oriole
Blue Jay	Black-headed Grosbeak

Mixed Hardwood Patches

Cooper's Hawk
Long-eared Owl
Mountain Bluebird

Juniper Patches

Six species were found nesting in junipers, none exclusively.

Ponderosa Pine Forest

Red-breasted Nuthatch
Audubon's Warbler

WHAT CAN BE DONE?

Based on this and other investigations we have made in western North Dakota, we recommend that the natural wooded areas in southwestern North Dakota be preserved and protected in perpetuity for:

1. The uniqueness of these habitats in North Dakota,
2. their practical influence in supporting desirable faunal communities unique to North Dakota,
3. the diverse and interesting animal species utilizing them,
4. their theoretical significance for study and comparison with other island situations throughout the world,
5. their interest to the public as a shelter and supplementary food source for livestock and game.

We recommend that studies be continued on a long-range basis to determine the population and habitat trends. Knowledge of these trends is essential to future sound management decisions.

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PUBLISHED BREEDING BIRD COUNTS

1979 COUNTS-AMERICAN BIRDS 34:54, 55, 62, 69, 75 (1980)

102. MIXED PRAIRIE. — Location: North Dakota; Billings Co., 3 mi W Medora; SE 1/4, SE 1/4, Sec. 19, T140N, R102W; 46°55'N, 103°36'W, Medora Quadrangle, USGS. Continuity: New. Size: 4.05 ha = 10 acres (rectangular, measured with compass and tape). Description of Plot: Western mixed-grass prairie site. Dominant grasses are W. Wheat Grass (*Agropyron smithii*), Blue Gramma (*Bouteloua gracilis*), Needle-and-thread (*Stipa comata*), Thread-leaved Sedge (*Carex filifolia*), Saltgrass (*Distichlis stricta*), Plains Muhly (*Muhlenbergia cuspidata*), Big Sand Grass (*Calamovilfa longifolia*), and Thickspike Wheat Grass (*A. dasystachyum*). Dominant shrubs are Dwarf Sagebrush (*Artemisia cana*), and Creeping Juniper (*Juniperus horizontalis*). Ground cover 30%, Grasses comprise 80% of ground cover, forbs 5%, and shrubs 15%. Edge: Bordered on the N by Andrews Creek, the E by an eroded coulee, on the W and S by similar prairie habitat. Topography: Rolling. Elevation: 2350 ft. Weather: Dry throughout period. Skies overcast to mostly clear. No precipitation during any census. Temperatures 55-70°F. Coverage: June 15, 18-19, 21, 23-25; between dawn and 1035. Total man-hours: 8.25. Census: W. Meadowlark, 1; Vesper Sparrow, 1; Killdeer, +; Brewer's Blackbird, +; Rufous-sided Towhee, +. Total: 5 species; 2 territorial males or females (49/km², 20/100 acres). Visitors: Marsh Hawk, Mourning Dove, Barn Swallow, Brown-headed Cowbird, Am. Goldfinch. Remarks: This site is located within the Little Missouri Nat'l Grasslands and is periodically grazed. Thanks to Greg Hiemenz for assistance in censusing. — J. M. WIEHE and FARRON WALLACE. Zoology Dept., N.D. State Univ., Fargo, N.D. 58105.

69. RED CEDAR COULEE. — Location: North Dakota; Billings Co., 1.5 mi NW of Medora; NE 1/4 of SW 1/4, Sec. 15, T140N, R102W; 46°56'N, 103°33'W, Medora Quadrangle, USGS. Continuity: New. Size: 1.54 ha = 3.8 acres (irregular shape; size determined by planimetric measurement from aerial photos, Soil Conservation Service). Description of Plot: A coulee with three "arms" merging into one and draining NW toward the Little Missouri River. Predominantly covered with Rocky Mountain Red Cedar (*Juniperus scopulorum*) with a small amount of Green Ash (*Fraxinus pennsylvanica*) at the NW point of the coulee. Dominant grasses are Little Rice Grass (*Oryzopsis micrantha*), Little Bluestem (*Andropogon scoparius*), Big Sand Grass (*Calamovilfa longifolia*), and Plains Muhly (*Muhlenbergia cuspidata*). Dominant shrubs are Creeping Juniper (*Juniperus horizontalis*), Dwarf Juniper (*J. communis*), Buckbrush (*Symphoricarpos occidentalis*), and Skunk Bush (*Rhus trilobata*). Ground cover 10%. Grasses comprise 30% of cover, forbs 10%, and shrubs 60%. Edge: Bordered on all sides by eroded Badlands. Topography: Rugged. Very steeply sloping from a high butte into the coulee. Moderately sloping from the head of the coulee to the bottom of the drainage. Surrounded by Badlands on all sides. Elevation: 2350-2450 ft. Weather: Skies overcast to mostly clear. Dry throughout period. No precipitation during any census. Temperatures 40-75°F. Coverage: June 2, 10-11, 13, 15, 18, 21; July 21; between dawn and 0910. Total man-hours: 7.2. Census: Rufous-sided Towhee, 4 (260, 105); Black-billed Magpie, 1; Black-and-white Warbler, 1; Chipping Sparrow, 1. Total: 4 species; 7 territorial males or females (455/km², 184/100 acres). Visitor: Brown-headed Cowbird. Remarks: Nest located: Black-billed Magpie, 1. This coulee lies within Theodore Roosevelt Nat'l Park (South Unit). The steepness of this site made it impossible to obtain quantitative data on the trees forming the canopy. — J. M. WIEHE and FARRON WALLACE. Zoology Dept., N.D. State Univ., Fargo, N.D. 58105.

40. COTTONWOOD FLOODPLAIN I. —

Location: North Dakota; Billings Co., 1.7 mi NW Medora; NW 1/4, SW 1/4, Sec. 15, and SW 1/4, SW 1/4, Sec. 16, T140N, R102W; 46° 56' N, 103° 33' W, Medora Quadrangle, USGS. **Continuity:** New. **Size:** 19 ha = 47 acres (irregular shaped; size determined by planimetric measurement from aerial photos, Soil Conservation Service). **Description of Plot:** Mature cottonwood floodplain forest. Canopy dominated by Cottonwood (*Populus deltoides*). Prominent shrubs are Buckbrush (*Symphoricarpos occidentalis*), Skunk Bush (*Rhus trilobata*), and Buffaloberry (*Shepherdia argentea*). Ground cover fairly sparse. Major species include Big Sand Grass (*Calamovilfa longifolia*), Kentucky Blue Grass (*Poa pratensis*), Marsh Muhly (*Muhlenbergia racemosa*), Canada Wild-rye (*Elymus canadensis*), Slender Wheat Grass (*Agropyron trachyaulum*), White Sweet Clover (*Melilotus alba*), and Yellow Sweet Clover (*M. officinalis*). A quantitative survey of the vegetation revealed the following: Trees 3 in. diameter and over based on 30 points from the point-center method, 80/acre (197/ha); total basal area 83.4 ft²/acre. Species comprising 100% of the total number of trees (tree/acre, relative density (%), relative dominance, and frequency in that order): Cottonwood, 47, 58.75, 92.75, 86.7; Rocky Mountain Red Cedar (*Juniperus scopulorum*), 31, 38.75, 7.01, 76.7; Green Ash (*Fraxinus pennsylvanica*), 2, 2.5, 0.23, 6.7. Trees by diameter size class (trees/acre, relative density (%), basal area in square feet/acre, and relative dominance in that order): A (3-6 in.) 22.7, 28.3, 2.5, 1.9; B (6.1-9 in.) 9.3, 11.7, 2.5, 4.7; C (9.1-15 in.) 12.7, 15.8, 11.4, 15.6; D (15.1-21 in.) 29.3, 36.7, 50.7, 30.1; E (21.1-27 in.) 6, 7.5, 16.4, 47.7. Ground cover 20%. Grasses comprise 40% of cover, forbs 40%, and shrubs 20%. Canopy cover about 85%; canopy height 45 to over 80 ft (average about 70 ft). **Edge:** Bordered on SW and NW by the Little Missouri River, on SE by upland prairie. **Topography:** Flat. **Elevation:** 2340 ft. **Weather:** Partly cloudy to clear. Dry throughout period. No precipitation during any census. **Temperatures** 40-70°F. **Wind** calm to 15 mph mostly from the S or SE. **Coverage:** June 2, 11, 15, 18, 21-24; July 21; between dawn and 0900 and 1930-2035. **Total man-hours:** 37.2. **Census:** House Wren, 23 (121, 49); Red-eyed Vireo, 18 (95, 35); Mourning Dove, 11 (58, 23); Am. Robin, 9 (47, 19); Rufous-sided Towhee, 9; Chipping Sparrow, 8 (42, 17); Ovenbird, 7.5 (39, 16); Com. Flicker, 7 (37, 15); Black-headed Grosbeak, 6.5 (34, 14); Warbling Vireo, 6 (32, 13); E. Kingbird, 4 (21, 9); Com. Yellowthroat, 3 (16, 6); Great Horned Owl, 2; Black-capped Chickadee, 2; Brown Thrasher, 2; Red-tailed Hawk, 1; Black-billed Cuckoo, 1; Red-headed Woodpecker, 1; Hairy Woodpecker, 1; Downy Woodpecker, 1; Blue Jay, 1; Gray Catbird, 1; Starling, 1; Yellow-breasted Chat, 1; Am. Kestrel, +; W. Meadowlark, +; Lazuli Bunting, +; Field Sparrow, +. **Total:** 28 species; 127 territorial males or females (668/km², 270/100 acres).

Visitors: Cooper's Hawk,

Spotted Sandpiper, Com. Nighthawk, Cliff Swallow, *Empidonax* sp., Black-billed Magpie, Com. Crow, White-breasted Nuthatch, Swainson's Thrush, Yellow Warbler, Am. Redstart, Red-winged Blackbird, N. Oriole, Am. Goldfinch, and Song Sparrow. **Remarks:** Nests found (22): Red-tailed Hawk, 1; Mourning Dove, 7; Black-billed Cuckoo, 1; Great Horned Owl, 2; Com. Flicker, 1; Red-headed Woodpecker, 1; Hairy Woodpecker, 1; Downy Woodpecker, 1; Brown Thrasher, 2; Black-headed Grosbeak, 4; Rufous-sided Towhee, 1. A large concentration of Com. Grackles was located at the SW end. They were too numerous to count and sort out into individual pairs with nest and dependent young. The Red-tailed Hawk nest apparently failed as did one Black-headed Grosbeak nest. Interstate 94 passes within 50 yds of the southernmost point of the plot. This area is located within the boundaries of Theodore Roosevelt Nat'l Park (South Unit). — J. M. WIEHE and FARRON WALLACE, Zoology Dept., N.D. State Univ., Fargo, N.D. 58105.

41. COTTONWOOD FLOODPLAIN II.

— Location: North Dakota; Billings Co., 0.5 mi SW of Medora, NW 1/4, SE 1/4, Sec. 27, T140N, R102W; 46°54'N, 103°32'W, Medora Quadrangle, USGS. Continuity: New. Size: 13 ha = 32.2 acres (irregular shape; size determined by planimetric measurement from aerial photos. Soil Conservation Service). Description of Plot: Mature cottonwood floodplain forest. Canopy dominated by Cottonwood (*Populus deltoides*). Prominent shrubs are Buckbrush (*Symphoricarpos occidentalis*), W. Wild Rose (*Rosa woodsii*), Skunk Bush (*Rhus trilobata*), Poison Ivy (*Toxicodendron rydbergii*), and Choke Cherry (*Prunus virginiana*). Major grasses include Big Sand Grass (*Calamovilfa longifolia*), Kentucky Blue Grass (*Poa pratensis*), and Marsh Muhly (*Muhlenbergia racemosa*). Major forbs include White Sweet Clover (*Melilotus alba*) and Yellow Sweet Clover (*M. officinalis*). A quantitative survey of the vegetation revealed the following: Trees 3-in. diameter and over based on 30 points from the point-center method, 75/acre (185/ha); total basal area 69.14 ft²/acre. Species comprising 100% of the total number of trees (trees/acre, relative density (%), relative dominance, and frequency in that order): Cottonwood, 40.6, 54, 91.67, 96.67; Rocky Mountain Red Cedar (*Juniperus scopulorum*), 32.5, 43, 8.05, 86.67; Green Ash (*Fraxinus pennsylvanica*), 1.9, 3, 0.28, 6.67. Trees by diameter size class (trees/acre, relative density (%), basal area in square feet/acre, and relative dominance in that order): A (3-6 in.) 24.4, 32.5, 2.6, 1.8; B (6.1-9 in.) 8.8, 11.7, 2.5, 4.7; C (9.1-15 in.) 14.4, 19.2, 14.3, 16.4; D (15.1-21 in.) 24.4, 32.5, 40.4, 27.3; E (21.1-27 in.) 3.1, 4.2, 9.4, 49.8. Ground cover 25%. Grasses comprise 15% of cover, forbs 25%, and shrubs 60%. Canopy cover about 70%; canopy height 45 to over 80 ft (average about 70 ft). Edge: Bordered on S and SE by the Little Missouri River, on NW and N by mixed prairie and an abruptly rising butte (Badlands). Topography: Flat. Elevation: 2260 ft. Weather: Overcast to clear. Mostly partly cloudy. Dry throughout period. No precipitation during any census. Temperatures 30-70°F. Winds mostly calm. Coverage: May 26; June 5, 10, 13, 17, 19, 21, 23, 25; July 22; between dawn and 1000 and 2000-2100. Total man-hours: 34.

Census: Red-eyed Vireo, 16 (123, 50); House Wren, 12 (92, 37); Mourning Dove, 11 (84, 34); Rufous-sided Towhee, 10.5 (81, 33); Ovenbird, 10 (77, 31); Chipping Sparrow, 8.5 (65, 26); Warbling Vireo, 8 (61, 25); Com. Flicker, 5 (38, 16); Com. Yellowthroat, 4.5 (35, 14); Black-headed Grosbeak, 4.5; Lazuli Bunting, 4.5; E. Kingbird, 4 (31, 12); Am. Robin, 4; Red-headed Woodpecker, 2; Blue Jay, 2; Am. Redstart, 2; Field Sparrow, 2; Red-tailed Hawk, 1; Turkey, 1; Hairy Woodpecker, 1; Downy Woodpecker, 1; Black-and-white Warbler, 1; Mallard, +; Ring-necked Pheasant, +; Yellow-breasted Chat, +; Com. Grackle, +. Total: 26 species; 115.5 territorial males or females (886/km², 359/100 acres). Visitors: Black-billed Cuckoo, Great Horned Owl, Com. Nighthawk, Black-billed Magpie, Com. Crow, Black-capped Chickadee, White-breasted Nuthatch, Yellow Warbler, W. Meadowlark, Orchard Oriole, N. Oriole, Rusty Blackbird, Brown-headed Cowbird, Am. Goldfinch, Song Sparrow. Remarks: Nests found (13): Red-tailed Hawk, 1; Turkey, 1; Mourning Dove, 4; Com. Flicker, 1; Downy Woodpecker, 1; E. Kingbird, 1; House Wren, 1; Black-headed Grosbeak, 2; Field Sparrow, 1. This site is located on the Chateau de Mores Historical Site (State Historical Society). Thanks to J. Frank Cassel and Greg Hiemenz for assistance in censusing. — J. M. WIEHE and FARRON WALLACE. Zoology Dept., N.D. State Univ., Fargo, N.D. 58105.

42. ASH - COTTONWOOD DRAW. —

Location: North Dakota; Billings Co., 9 mi S Medora; SE 1/4 of SW 1/4, Sec. 12, T138N, R102W; 46°47'N, 103°30'W, Tracy Mountain Quadrangle, USGS. Continuity: New. Size: 3 ha = 7.4 acres (size determined by planimetric measurement from aerial photos, Soil Conservation Service). Description of Plot: Mature ash-cottonwood draw. Dominant canopy trees are Green Ash (*Fraxinus pennsylvanica*) and Black Cottonwood (*Populus trichocarpa*). Prominent shrubs are Buckbrush (*Symphoricarpos occidentalis*) and W. Wild Rose (*Rosa woodsii*). Ground cover fairly sparse. Major species include Little Rice Grass (*Oryzopsis microantha*) and N. Bedstraw (*Galium boreale*). A quantitative survey of the vegetation showed the following: Trees 3-in. diameter and over based on 30 points from point-center method, 126/acre (363/ha); total basal area 32.18 ft²/acre. Species comprising 100% of the total number of trees (trees/acre, relative density (%), relative dominance, and frequency in that order): Green Ash, 71, 37, 13.5, 93; Black Cottonwood, 54, 48, 81, 73; Rocky Mountain Red Cedar (*Juniperus scopulorum*), 16, 11, 3.4, 30; Box-elder (*Acer negundo*), 6, 4, 2.24, 13. Trees by diameter size class (trees/acre, relative density (%), basal area in square feet/acre, relative dominance in that order): A (3-6 in.) 69.3, 55, 7.1, 10; B (6.1-9 in.) 30.1, 24, 9.4, 31; C (9.1-15 in.) 26.6, 21, 15.7, 59. Ground cover 20%. Grasses comprise 15% of cover, forbs 15%, and shrubs 70%. Canopy cover about 90%; canopy height 15 to over 60 ft, average height about 45 ft. Edge: Bordered on N by a steep Red Cedar covered slope; other edges by upland prairie. Topography: A wooded coulee (draw) sloping down toward the north. Elevation: 2750-2800 ft. Weather: Fairly dry throughout period. Skies clear to partly cloudy; no precipitation. Temperatures 35-75°F. Coverage: May 16, 18, 28, 31; June 14, 16, 19-20, 22; between dawn and 0945 and 2025-2125. Total man-hours: 10.2. Census: Rufous-sided Towhee, 7 (234, 95); Ovenbird, 4 (134, 54); Chipping Sparrow, 4; Red-eyed Vireo, 3 (100, 41); Lazuli Bunting, 3; House Wren, 2; Com. Flicker, 1; Am. Robin, 1; Black-and-white Warbler, 1. Total: 9 species; 26 territorial males or females (868/km², 351/100 acres). Visitors: Sharp-shinned Hawk, Turkey, Mourning Dove, Saw-whet Owl, Black-capped Chickadee, Red-breasted Nuthatch, Brown Thrasher. Remarks: This is the only area in the state where Black Cottonwood is found; this species is rarely found E of the Rocky Mountains. A spring and a stock tank are located near the bottom of this draw. Heavy cattle use of this area has resulted in sparse ground cover. No reproduction of Black Cottonwood was evident at this site. — J. M. WIEHE and FARROW WALLACE, Zoology Dept., N.D. State Univ., Fargo, N.D. 58105.

43. ASH - ELM HARDWOOD DRAW. —

Location: North Dakota; Billings Co., 10 mi S Medora; SE 1/4, NW 1/4, Sec. 13, T138N, R102W; 46°46'N, 103°30'W, Tracy Mountain Quadrangle, USGS. Continuity: New. Size: 2.87 ha = 7.1 acres (irregular shape; size determined by planimetric measurement from aerial photos, Soil Conservation Service). Description of Plot: Mature ash-elm hardwood draw. Dominant canopy trees are Green Ash (*Fraxinus pennsylvanica*) and Am. Elm (*Ulmus americana*). Prominent shrubs are W. Wild Rose (*Rosa woodsii*), Buckbrush (*Symphoricarpos occidentalis*), Choke Cherry (*Prunus virginiana*), Skunk Bush (*Rhus trilobata*), and Buffaloberry (*Shepherdia argentea*). Major grasses and forbs are Kentucky Blue Grass (*Poa pratensis*), Little Rice Grass (*Oryzopsis microantha*), and N. Bedstraw (*Galium boreale*). A quantitative survey of the vegetation provided the following data: Trees 3-in. diameter and larger based on 30 points from point-center method, 214.52/acre (530/ha); total basal area 84.97 ft²/acre. Species comprising 98% of the total number of trees (trees/acre, relative density (%), relative dominance, and frequency in that order): Green Ash, 146.6, 68.3, 65.23, 93.3; Am. Elm, 60, 27.5, 34, 66.7; Red Cedar (*Juniperus scopulorum*), 5.36, 2.5, 0.356, 6.67. Trees by diameter size class (trees/acre, relative density (%), basal area in square feet/acre, and relative dominance in that order): A (3-6 in.) 71.5, 33.3, 7.98, 1.84; B (6.1-9 in.) 85.8, 40, 26.1, 5.02; C (9.1-15 in.) 48.3, 22.5, 32.8, 11.2; D (15.1-21 in.) 7.2, 3.3, 12.4, 28.3; E (21.1-27 in.) 1.8, 0.8, 5.9, 53.6. Ground cover 30%. Grasses comprise 10% of cover, forbs 10%, and shrubs 80%. Canopy cover about 70%; canopy height 15-40 ft, average about 30 ft. Edge: Bordered on N and E by open prairie, on S by a shrubby transition zone from trees to prairie. Elevation: 2750-2800 ft. Topography: Located on the N-facing slope of a broad coulee draining to the W. Fairly flat bottom in the draw rising to the SE. The plot rises to the S, up the N-facing slope toward the top of a high plateau. Weather: Fairly dry throughout period. Skies mostly clear; no precipitation. Temperatures 35-75°F. Coverage: May 16, 30; June 1, 14, 16, 19-20, 22; between dawn and 0950 and 2030-2130. Total man-hours: 10.33. Census: Rufous-sided Towhee, 8 (278, 113); House Wren, 3.5 (122, 49); Red-eyed Vireo, 3 (104, 42); Yellow-breasted Chat, 2; Lazuli Bunting, 2; Chipping Sparrow, 2; Field Sparrow, 2; Cooper's Hawk, 1; Long-eared Owl, 1; Com. Crow, 1; Black-capped Chickadee, 1; Black-and-white Warbler, 1; Am. Redstart, 1; Lark Sparrow, 1. Total: 14 species; 29.5 territorial males or females (1027/km², 415/100 acres). Visitors: Ring-necked Pheasant, Turkey, Rusty Blackbird, Am. Goldfinch, Song Sparrow. Remarks: Nests located (3): Com. Crow, 1; Black-capped Chickadee, 1; Chipping Sparrow, 1. Heavy cattle use (trail plus grazing) along the bottom of this SE to NW oriented draw. Special thanks to J. Frank Cassel for assistance in censusing. — J. M. WIEHE, Zoology Dept., N.D. State Univ., Fargo, N.D. 58105.

126. PONDEROSA PINE I. — Location: North Dakota; Slope Co., 11 mi NW Amidon, NW $\frac{1}{4}$, NW $\frac{1}{4}$, Sec. 21, T136N, R102W; 46° 35'N, 103°30'W, U.S. Forest Service, Little Missouri Nat'l Grasslands map. Continuity: New. Size: 20.25 ha = 50 acres (rectangular, borders determined by compass and measuring tape). Description of Plot: Canopy almost entirely mature Ponderosa Pine (*Pinus ponderosa*). Prominent shrubs are: Buckbrush (*Symphoricarpos occidentalis*) and Creeping Juniper (*Juniperus horizontalis*). Major grasses are: Little Bluestem (*Andropogon scoparius*), Side-oats Gramma (*Bouteloua curtipendula*), Big Sandgrass (*Calamovilfa longifolia*), W. Wheat Grass (*Agropyron smithii*), Plains Muhly (*Muhlenbergia cuspidata*), Thread-leaved Sedge (*Carex filifolia*), Needle-and-thread (*Stipa comuta*), Red Three-awn (*Aristida longiseta*), and Bluebunch Wheat Grass (*A. spicatum*). A quantitative analysis of the area showed the following: Trees 3 in. diameter and over based on 30 points from the point-center method, 105.64 trees/acre (260.93/ha); total basal area 50.8 ft²/acre. Species comprising 100% of the total number of trees (trees/acre, relative density (%), relative dominance, and frequency in that order): Ponderosa Pine, 100.36, 95, 97.5, 100; Green Ash (*Fraxinus pennsylvanica*), 44, 4, 2.34, 13.3; Rocky Mountain Red Cedar (*Juniperus scopulorum*), 0.88, 1, 0.15, 3.3. Trees by diameter size class (trees/acre, relative density (%), basal area in square/acre, and relative dominance in that order): A (3-6 in.) 35.2, 33.3, 4.9, 2.3; B (6.1-9 in.) 30, 28.3, 10.2, 5.6; C (9.1-15 in.) 37, 35, 28.2, 12.7; D (15.1-21 in.) 2.6, 2.5, 5.1, 32.2; E (21.1-27 in.) 0.9, 0.8, 2.5, 47.2. Ground cover 30%. Grasses comprise 75% of cover, forbs 5%, and shrubs 20%. Canopy cover about 35%. Canopy 20-50 ft, average height about 40 ft. Edge: Bordered on S by a pine-to-open prairie transition; on other 3 sides by similar habitat. Topography: Series of pine covered ridges and slopes. Ridges moderately to steeply sloping into draws between ridges. Elevation 2550-2600 ft. Rocky outcrops frequent on area. Weather: Fairly dry throughout, except for high winds and heavy rainfall the night of June 18-19. No rain during any census. Coverage: June 9, 12-20; 0355-1010 and 2000-2155. Total man-hours: 41. Census: Chipping Sparrow, 18 (89, 36); Ovenbird, 12 (59, 24); Rufous-sided Towhee, 6.5 (32, 13); Black-and-white Warbler, 5 (25, 10); Black-capped Chickadee, 4 (20, 8); Com. Yellowthroat, 3 (15, 6); Yellow-rumped Warbler, 2.5; Mourning Dove, 1.5; Marsh Hawk, 1; Com. Crow, +. Total: 10 species; 53.5 territorial males and females (264/km², 107/100 acres). Visitors: Merlin, Turkey, Great Horned Owl, Poor-will, Com. Night-hawk, Com. Flicker, House Wren, Am. Robin, Mountain Bluebird, W. Meadowlark, Red Crossbill. Remarks: Nest found: Marsh Hawk, 1. A female Turkey attacked one of us, but no nest or young could be located. Several young of the year were observed with their parents, especially Chipping Sparrows. Farron Wallace and Greg Hiemenz helped lay out the area. — J. FRANK CASSEL, JAY CASSEL, and J. M. WIEHE, Zoology Dept., N.D. State Univ., Fargo, N.D. 58105.

127. PONDEROSA PINE II. — Location: North Dakota; Slope Co., 9.5 mi NW, Amidon; NE $\frac{1}{4}$, SW $\frac{1}{4}$, Sec. 14, T136N, R102W; 46°35'N, 103°28'W, Rocky Ridge Quadrangle, USGS. Continuity: New. Size: 4.05 ha = 10 acres (square, measured with compass and tape). Description of Plot: Mature Ponderosa Pine (*Pinus ponderosa*) stand forming canopy. Prominent shrubs are Creeping Juniper (*Juniperus horizontalis*) and Buckbrush (*Symphoricarpos occidentalis*). Major grasses and forbs are Little Bluestem (*Andropogon scoparius*), Side-oats Gramma (*Bouteloua curtipendula*), Plains Muhly (*Muhlenbergia cuspidata*), Bluebunch Wheat Grass (*Agropyron spicatum*), Big Sand Grass (*Calamovilfa longifolia*), and Yellow Sweet Clover (*Melilotus officinalis*). A quantitative analysis of the area showed the following: Trees 3 in. diameter and over based on 30 points from point-center method, 153.71/acre (379.67/ha); total basal area 383.46 ft²/acre. Species comprising 100% of the total number of trees (trees/acre, relative density (%), relative dominance, and frequency in that order): Ponderosa Pine 152.43, 99.2, 99.7, 100; Green Ash (*Fraxinus pennsylvanica*) 1.28, 0.08, 0.03, 3.3. Trees by diameter size class (trees/acre, relative density (%), basal area in square ft/acre, and relative dominance in that order): A (3-6 in.) 61.5, 40, 7.5, 4.3; B (6.1-9 in.) 46.1, 30, 13.8, 10.6; C (9.1-15 in.) 42.3, 27.5, 31.8, 26.6; D (15.1-21 in.) 3.8, 2.5, 6.3, 58.6. Ground cover 25%. Grasses comprise 35% of cover, forbs 5%, and shrubs 60%. Canopy cover about 50%; canopy height 20-40 ft, average height about 30 ft. Edge: Bordered on NE and SE sides by pine-to-prairie transition. Bordered on NW and SW sides by similar Ponderosa Pine habitat. Topography: Series of high pine-covered ridges and slopes. Moderate to steep slopes into NW draining draws. Rock outcrops frequent on area. Weather: Fairly dry throughout period. Skies mostly partly cloudy. No precipitation during any census. Temperatures 35-85°F. Coverage: June 9, 13-19; between dawn and 1100 and 2050-2140. Total man-hours: 12.42. Census: Chipping Sparrow, 3.5 (86, 35); Rufous-sided Towhee, 2.5; Com. Nighthawk, +. Total: 3 species; 6 territorial males or females (148/km², 60/100 acres). Visitors: Mourning Dove, Great Horned Owl, Poor-will, Com. Flicker, Black-billed Magpie, Black-and-white Warbler, Yellow-rumped Warbler, W. Meadowlark. Remarks: Turkey scat were seen on the area frequently. Thanks to Farron Wallace for assistance in censusing. — JAY CASSEL, J. FRANK CASSEL, and J. M. WIEHE, Zoology Dept., N.D. State Univ., Fargo, N.D. 58105.

1980 Counts

AMERICAN BIRDS

35:77, 79-84 (1981)

AVIAN COMMUNITY STUDIES IN
NORTH DAKOTA

Renewed and increasing interest in exploiting the vast lignite reserves in North Dakota is motivating serious concern about the environmental impact of strip mining. Special attention is being given to the problems arising from the possible destruction and the legally required reclamation of "woody draws." Wooded habitats in the grassland biome are usually restricted to floodplains and to steeper drainage courses known locally as draws. In these draws, trees (*Fraxinus*, *Ulmus*, *Populus*), seldom over 50 ft tall, are interspersed with tall shrubs (*Prunus*, *Crataegus*, *Shepherdia*, *Amelanchier*, *Eleagnus*), short shrubs (*Symphoricarpos*, *Rosa*, *Artemisia*), and/or extensions of prairie grassland. Many draws have no woody vegetation or only shrubs. Hence, patchy dispersion and islands of woody growth are typical. The fragile nature of the badlands and the relative scarcity of natural wooded areas make the preservation of an adequate number of them essential to retaining the integrity of the ecology of the northern plains.

The following counts, and others included under the appropriate habitat classes, record some of the data derived from studies in central North Dakota on the Glenharold Mine area near Stanton supported by Consolidation Coal Company in response to questions from N.D. Public Service Commission. Reports by John Fleckenstein and Steve Mack cover this area. In the SW part of the state, studies by Greg Hiemenz and Farron Wallace report on birds in natural, planted, and reclamation wooded areas done as part of a study by the North Dakota Game and Fish Department in cooperation with and supported by the Bureau of Land Management. Other natural wooded areas in the badlands area were studied by John Wiehe, Farron Wallace and others in 1979 and by Rick Hopkins and Michael Schwartz in 1980, supported by the Forest Service. All are working under grants by the various agencies to North Dakota State University.—J. FRANK CASSEL, Zoology Dept., N.D.S.U., Fargo, N.D. 58105.

111. MIXED PRAIRIE I.—Location: North Dakota; Billings Co., 3 mi W Medora, SE 1/4, SE 1/4, Sec. 19, T140N, R102W; 46°55'N, 103°36'W, Medora Quadrangle, USGS. Continuity: Established 1979. Size: 4.05 ha = 10 acres. Description of Plot: See AB 34:69 (1980). Weather: Skies clear to overcast. Temperatures 45°-74°F. Winds calm to 25 mph. Coverage: Apr. 25; May 10, 23, 30; June 3, 10, 17, 20-21; 0425-0830 and 2025-2045, MDT. Total hours: 7.5. Census: W. Meadowlark, 2; Mourning Dove, 1; Vesper Sparrow, 1. Total: 3 species; 4 territorial males or females (99/km², 40/100 acres). Visitors: Marsh Hawk, Sharp-tailed Grouse, Killdeer, Brown-headed Cowbird, Grasshopper Sparrow, Clay-colored Sparrow, Field Sparrow. Remarks: One Mourning Dove nest located. This site is located within the Little Missouri Nat'l Grasslands and is grazed. Thanks to Farron Wallace for assistance in censusing.—MICHAEL D. SCHWARTZ and RICK HOPKINS, Zoology Dept., N.D. State Univ., Fargo, N.D. 58105.

112. MIXED PRAIRIE II.—Location: North Dakota; Billings Co., 10 mi S Medora SW 1/4, NE 1/4, Sec. 13, T138N, R102W; 46°45'N, 103°30'W, U.S. Forest Service Nat'l Grasslands Map. Continuity: New. Size: 10.1 ha = 25 acres (rectangular size determined by compass and tape). Description of Plot: The predominant grasses include Needle-and-thread (*Stipa comata*), W. Wheat Grass (*Agropyron smithii*), and Blue Grama (*Bouteloua gracilis*). Locally abundant grasses were Little Bluestem (*Andropogon scoparius*) and Prairie Sandreed (*Calamovilfa longifolia*). Threadleaf Sedge (*Carex filifolia*) was also abundant. A patch of Wolfberry (*Symphoricarpos occidentalis*) was located near the center of the plot. A few scattered Silver Sage (*Artemisia cana*) were found. Because of drought conditions the vegetation was poorly developed. Edge: Bordered on all sides by similar grasslands. There is a brushy draw near the S boundary and a hardwood draw a short distance from the N boundary. Topography: Gently rolling prairie, sloping slightly E. Elevation: 2926 ft. Weather: Skies clear to overcast. Winds calm to 15 mph. Temperatures 33-65°F. Coverage: Apr. 29; May 12, 27; June 1, 5, 11, 18, 22; 0420-0745, MDT. Total hours: 6.6. Census: W. Meadowlark, 2; Brewer's Blackbird, 1. Total: 2 species; 3 territorial males or females (30/km², 12/100 acres). Visitors: Sharp-tailed Grouse, Gray Partridge, Long-billed Curlew, Upland Plover, Mourning Dove, Horned Lark, Black-billed Magpie, Com. Crow, Vesper Sparrow. Remarks: This grassland is located within the Little Missouri Nat'l Grasslands and is grazed by cattle.—MICHAEL D. SCHWARTZ and RICK HOPKINS, Zoology Dept., N.D. State Univ., Fargo, N.D. 58105.

132. COTTONWOOD FLOODPLAIN

I.—Location: North Dakota; Billings Co., 1.7 mi NW Medora, NW 1/4, SW 1/4, Sec. 15, and SE 1/4, Sec. 16, T140N, R102W; 46°56'N, 103°33'W, Medora Quadrangle, USGS. Continuity: Established 1979. Size: 19 ha = 47 acres. Description of Plot: See AB 34:54 (1980). Weather: Skies clear to overcast. Temperatures 29-84°F. Winds calm to 15 mph. Coverage: Apr. 28; May 11, 30; June 3-4, 9, 17, 20, 22; 0445-0925 and 1905-2120, MDT. Total hours: 35.5. Census: House Wren, 16 (84, 34); Mourning Dove, 15 (79, 32); Am. Robin, 12 (63, 26); Rufous-sided Towhee, 12; Chipping Sparrow, 12; Com. Flicker, 8 (42, 17); Red-eyed Vireo, 8; Ovenbird, 7 (37, 15); E. Kingbird, 5 (26, 11); Black-capped Chickadee, 4 (21, 9); Warbling Vireo, 4; Am. Kestrel, 3 (16, 6); Starling, 3; Black-headed Grosbeak, 2.5; Hairy Woodpecker, 2; Downy Woodpecker, 2; Black-and-white Warbler, 2; Com. Yellowthroat, 2; Field Sparrow, 1.5; Red-tailed Hawk, 1; Turkey, 1; Ring-necked Pheasant, 1; Red-headed Woodpecker, 1; Blue Jay, 1; White-breasted Nuthatch, 1; Yellow Warbler, 1; N. (Baltimore) Oriole, 1; N. (Bullock's) Oriole, 1; Lazuli Bunting, 0.5. Total: 28 species (29 forms); 130.5 territorial males or females (686/km², 278/100 acres). Visitors: Mallard, Com. Nighthawk, Belted Kingfisher, *Empidonax* sp., Black-billed Magpie, Brown Thrasher, W. Meadowlark, Am. Redstart, Red-winged Blackbird, Orchard Oriole, Brown-headed Cowbird, Am. Goldfinch, Red Crossbill. Remarks: Nests located (21): Red-tailed Hawk, 1; Turkey, 1; Mourning Dove, 5; Com. Flicker, 3; E. Kingbird, 2; House Wren, 1; Am. Robin, 3; Starling, 3; Black-headed Grosbeak, 2. Species showing substantial decreases were: Great Horned Owl, 2 to 0; House Wren, 23 to 16; Red-eyed Vireo, 18 to 8; Black-headed Grosbeak, 6.5 to 2.5. Species showing increases were: Am. Kestrel, + to 3; Mourning Dove, 11 to 15; Chipping Sparrow, 8 to 12. This area is located within the boundaries of Theodore Roosevelt Nat'l Park (South Unit). This site may receive some grazing from a herd of bison. Thanks to Farron Wallace for assistance in censusing.—RICK HOPKINS and MICHAEL D. SCHWARTZ, Zoology Dept., N.D. State Univ., Fargo, N.D. 58105.

133. COTTONWOOD FLOODPLAIN

II.—Location: North Dakota; Billings Co., 0.5 mi SW Medora, NW 1/4, SE 1/4, Sec. 27, T140N, R102W; 46°54'N, 103°32'W, Medora Quadrangle, USGS. Continuity: Established 1979. Size: 13 ha = 32.2 acres. Description of Plot: See AB 34:54 (1980). Weather: Skies clear to overcast. Temperatures 28-78°F. Winds calm to 20 mph. Coverage: Apr. 25; May 7, 22, 31; June 4, 10, 18, 21, 24; 0435-1100 and 1910-2050, MDT. Total hours: 29.5. Census: House Wren, 10 (77, 31); Rufous-sided Towhee, 10; Com. Flicker, 8 (61, 25); Red-eyed Vireo, 8; Ovenbird, 8; Am. Robin, 7 (54, 22); Mourning Dove, 6 (46, 19); Chipping Sparrow, 6; E. Kingbird, 3 (23, 9); Black-headed Grosbeak, 3; Red-headed Woodpecker, 2; Hairy Woodpecker, 2; Blue Jay, 2; Warbling Vireo, 2; Com. Yellowthroat, 2; Field Sparrow, 1.5; Am. Kestrel, 1; Ring-necked Pheasant, 1; Black-billed Magpie, 1; Black-capped Chickadee, 1; White-breasted Nuthatch, 1; Starling, 1; Black-and-white Warbler, 1; Am. Redstart, 1; Yellow Warbler, 0.5; Brown-headed Cowbird, 0.5; Lazuli Bunting, 0.5. Total: 27 species; 90 territorial males or females (691/km², 280/100 acres). Visitors: Great Blue Heron, Mallard, Cooper's Hawk, Turkey, Com. Nighthawk, Belted Kingfisher, Downy Woodpecker, W. Wood Pewee, Com. Crow, Gray Catbird, Brown Thrasher, Yellow-breasted Chat, W. Meadowlark, N. (Baltimore) Oriole, N. (Bullock's) Oriole, Com. Grackle, Am. Goldfinch. Remarks: Nests located (10): Mourning Dove, 1; Com. Flicker, 2; Red-headed Woodpecker, 1; Hairy Woodpecker, 1; E. Kingbird, 1; White-breasted Nuthatch, 1; Am. Robin, 1; Black-headed Grosbeak, 1; Rufous-sided Towhee, 1. Species showing substantial decreases were: Red-eyed Vireo, 16 to 8; Mourning Dove, 11 to 6; Warbling Vireo, 8 to 2; Lazuli Bunting, 4.5 to 0.5. Territorial males decreased from 115.5 to 90.—MICHAEL D. SCHWARTZ and RICK HOPKINS, Zoology Dept., N.D. State Univ., Fargo, N.D. 58105.

125. ASH-COTTONWOOD DRAW.
 —Location: North Dakota; Billings Co., 9 mi S Medora; SE 1/4, SW 1/4, Sec. 12, T138N, R102W; 46°47'N, 103°30'W, Tracy Mountain Quadrangle, USGS. Continuity: Established 1979. Size: 3 ha = 7.4 acres. Description of Plot: See AB 34:42 (1980). Weather: Skies clear to overcast. Light rain during one count. Temperatures between 35-82°. Winds calm to 20 mph. Coverage: Apr. 29; May 12, 29; June 1, 5, 11, 18, 22, 24-25; 0430-0940 and 1910-2025, MDT. Total hours: 15.25. Census: Rufous-sided Towhee, 8 (267, 108); Ovenbird, 5 (167, 68); Mourning Dove, 3 (100, 41); Black-and-white Warbler, 3; Am. Redstart, 3; Chipping Sparrow, 3; Com. Flicker, 2; Am. Robin, 2; Red-eyed Vireo, 2; Black-capped Chickadee, 1; Lazuli Bunting, 1. Total: 11 species; 33 territorial males or females (1102/km², 446/100 acres). Visitors: Marsh Hawk, Am. Kestrel, Turkey, Com. Crow, House Wren, Gray Catbird, Brown Thrasher, W. Meadowlark, Vesper Sparrow, Field Sparrow. Remarks: Nests found (3), Mourning Dove, 1; Com. Flicker, 2. Heavy cattle use of the area has resulted in sparse ground cover. Thanks to Farron Wallace for assistance in censusing.—**RICK HOPKINS** and **MICHAEL D. SCHWARTZ**, Zoology Dept., N.D. State Univ., Fargo, N.D. 58105.

126. ASH-ELM HARDWOOD DRAW, I.—Location: North Dakota; Billings Co., 10 mi S Medora (SE 1/4, NW 1/4, Sec. 13, T138N, R102W); 46°46'N, 103°30'W, Tracy Mountain Quadrangle, USGS. Continuity: Established 1979. Size: 2.87 ha = 7.1 acres. Description of Plot: See AB 34:55 (1980). Weather: Skies clear to overcast. Light rain during 1 count. Temperatures 24-82°F. Winds calm to 20 mph. Coverage: Apr. 26; May 8, 27, 29; June 1, 5, 11, 22, 24-25; 0430-0955 and 1910-2025, MDT. Total hours: 15.75. Census: Rufous-sided Towhee, 16 (557, 225); Chipping Sparrow, 4 (139, 56); Red-eyed Vireo, 3 (104, 42); Black-and-white Warbler, 3; Field Sparrow, 2.5; Am. Redstart, 2; Lark Sparrow, 2; Turkey, 1; Black-capped Chickadee, 1; Am. Goldfinch, 1; Lazuli Bunting, 1; Vesper Sparrow, 1. Total: 12 species; 37.5 territorial males or females (1305/km², 528/100 acres). Visitors: Swainson's Hawk, Sharp-tailed Grouse, Com. Crow, House Wren, Brown Thrasher, Am. Robin, Mountain Bluebird, Yellow Warbler, Ovenbird, Com. Yellowthroat, Com. Grackle, Brown-headed Cowbird, Song Sparrow. Remarks: Nests located (2): Rufous-sided Towhee, Field Sparrow. Approximately 15 young Turkeys were seen on the plot. Rufous-sided Towhees showed a substantial increase from 8 to 16. Black-and-white Warblers increased from 1 to 3. House Wrens decreased from 3.5 to 0 and Yellow-breasted Chats decreased from 2 to 0. There is heavy cattle use along the bottom of this draw. Thanks to Farron Wallace for assistance in censusing.—**MICHAEL D. SCHWARTZ** and **RICK HOPKINS**, Zoology Dept., N.D. State Univ., Fargo, N.D. 58105.

142. PONDEROSA PINE I.—Location: North Dakota; Slope Co., 11 mi NW Amidon, NW 1/4, NW 1/4, Sec. 21, T136N, R102W; 46°35'N, 103°30'W, U.S. Forest Service, Little Missouri Nat'l Grasslands Map. Continuity: Established 1979. Size: 20.23 ha = 50 acres. Description of Plot: See AB 34:75 (1980). Weather: Skies clear to overcast. Temperatures 34-65°F. Winds calm to 20 mph. Coverage: Apr. 30; May 13, 29; June 2, 6, 12, 16, 18-19; 0835-0905 and 1900-2045, MDT. Total hours: 27.6. Census: Chipping Sparrow, 24.5 (121, 49); Rufous-sided Towhee, 11.5 (57, 23); Ovenbird, 9.5 (47, 19); Com. Yellowthroat, 8 (40, 16); Black-capped Chickadee, 5.5 (27, 11); Black-and-white Warbler, 5 (25, 10); Mourning Dove, 4.5 (22, 9); Red-breasted Nuthatch, 3.5 (17, 7); Yellow-rumped Warbler, 3.5; Am. Kestrel, 1; Turkey, 1; Red-eyed Vireo, 1; Ring-necked Pheasant, +. Total: 13 species, 78.5 territorial males or females (388/km², 157/100 acres). Visitors: W. Kingbird, Com. Crow, White-breasted Nuthatch, House Wren, Am. Robin, Mountain Bluebird, Yellow Warbler, Bay-breasted Warbler, Com. Grackle, Brown-headed Cowbird, Red Crossbill, Clay-colored Sparrow. Remarks: Nests located (2): Mourning Dove, Chipping Sparrow. Five immature Turkeys were seen. The following species showed substantial increases: Com. Yellowthroat, 3 to 8; Rufous-sided Towhee, 6.5 to 11.5; Chipping Sparrow, 18 to 24.5. Territorial males increased from 53 to 78.5. Thanks to Farron Wallace for assistance in censusing.—**MICHAEL D. SCHWARTZ** and **RICK HOPKINS**, Zoology Dept., N.D. State Univ., Fargo, N.D. 58105.

143. PONDEROSA PINE II.—Location: North Dakota; Slope Co., 9.5 mi NW Amidon, NE 1/4, SW 1/4, Sec. 14, T136N, R102W, 46°35'N, 103°28'W, Rocky Ridge Quadrangle, USGS. Continuity: Established 1979. Size: 4.05 ha = 10 acres. Description of Plot: See AB 34:75 (1980). Weather: Clear to mostly cloudy. Temperatures 33-67°F. Winds calm to 20 mph. Coverage: Apr. 27; May 9, 29; June 2, 6, 12, 16, 18-19; 0425-0820 and 1905-1955, MDT. Total hours: 11. Census: Chipping Sparrow, 5 (124, 50); Rufous-sided Towhee, 3 (74, 30); Turkey, 1; Black-capped Chickadee, 1; Yellow-rumped Warbler, 1. Total: 5 species; 11 territorial males or females (272/km², 110/100 acres). Visitors: Mourning Dove, Black-billed Magpie, White-breasted Nuthatch, Ovenbird, Com. Yellowthroat, Red Crossbill, Field Sparrow. Remarks: Nest located: Turkey. Chipping Sparrows increased from 3.5 to 5. New nesting species were: Turkey, Black-capped Chickadee, Yellow-rumped Warbler. Territorial males increased from 6 to 11. Thanks to Farron Wallace for assistance in censusing.—**RICK HOPKINS** and **MICHAEL D. SCHWARTZ**, Zoology Dept., N.D. State Univ., Fargo, N.D. 58105.

137. RED CEDAR-MIXED GRASS PRAIRIE DRAW.—Location: North Dakota; Billings Co., 11 mi S Medora, SE 1/4, NW 1/4, Sec. 23, T138N, R102W; 46°45'N, 103°31'W, U.S. Forest Service, Little Missouri National Grasslands Map. Continuity: New (1979). Size: 2.6 ha = 6.4 acres (irregular shape; size determined by planimetric measurement of aerial photos, Soil Conservation Service). Description of Plot: A mixed grass prairie coulee with Rocky Mountain Cedar (*Juniperus scopulorum*) growing on the N-facing slope. Dominant grasses are W. Wheat Grass (*Agropyron smithii*), Blue Grama (*Bouteloua gracilis*), Big Sand Grass (*Calamovilfa longifolia*), Little Bluestem (*Andropogon scoparius*), Plains Muhly (*Muhlenbergia cuspidata*), and Side-oats Grama (*B. curtipendula*). Dominant shrubs are Skunk Bush (*Rhus trilobata*), Dwarf Sagebrush (*Artemisia cana*), Wolfberry (*Symphoricarpos occidentalis*), Buffaloberry (*Shepherdia argentea*), and Creeping Juniper (*J. horizontalis*). Ground cover 15%. Grasses comprise 50% of cover, forbs 5%, and shrubs 45%. Edge: Bordered on all sides by mixed grass prairie. Topography: Moderate eroded slopes into the coulee from surrounding rolling prairie. Elevation: 2450 ft. Weather (1979): Skies mostly clear to overcast. Temperatures 55-70°F; (1980): Skies clear to overcast. Light rain during 1 census count. Temperatures 25-65°. Winds calm to 15 mph. Coverage (1979): June 12, 14, 16, 19-22, 24, 26; between dawn and 1000 and 2000-2030. Total hours: 11.2. (1980): Apr. 26; May 8, 27; June 1, 5, 11, 18, 22; 0430-0810, MDT. Total hours: 7.3. Census (1979): Rufous-sided Towhee, 6 (232, 94); Chipping Sparrow, 4 (153, 63); Mourning Dove, 1; Vesper Sparrow, 1; W. Meadowlark, +; Field Sparrow, +. Total: 6 species; 12 territorial males or females (463/km² 188/100 acres). Visitors: Black-billed Cuckoo, Com. Nighthawk, Barn Swallow, Black-capped Chickadee, Am. Robin, Brown-headed Cowbird, Lark Sparrow, Clay-colored Sparrow. Remarks: Nests located: Mourning Dove, 1; Vesper Sparrow, 1. (1980): Rufous-sided Towhee, 3 (116, 47); Chipping Sparrow, 2; Field Sparrow, 2; Black-billed Magpie, 1. Total: 4 species; 8 territorial males or females (309/km², 125/100 acres). Visitors: Am. Redstart, Vesper Sparrow. Remarks: Nest located: Black-billed Magpie. Species showing decreases were: Rufous-sided Towhee, 6 to 3; Chipping Sparrow, 4 to 2. This site is part of the Little Missouri Nat'l Grasslands and is subject to periodic cattle grazing. J.M. Wiehe and F. Wallace, conducted vegetation analysis and census counts on this area in 1979. Thanks to F. Wallace for assistance in current years censusing.—**RICK HOPKINS and MICHAEL D. SCHWARTZ**, Zoology Dept., N.D. State Univ., Fargo, N.D. 58105.

144. RED CEDAR COULEE.—Location: North Dakota; Billings Co., 1.5 mi NW Medora, SW 1/4, SE 1/4, Sec. 15, T140N, R102W; 46°56'N, 103°33'W, Medora Quadrangle, USGS. Continuity: Established 1979. Size: 1.54 ha = 3.8 acres. Description of Plot: See AB 34:62 (1980). Weather: Skies mostly clear. Temperatures 26-60°F. Winds calm to 25 mph. Coverage: Apr. 25; May 7, 23, 30; June 3, 9, 17, 18, 20; 0425-0905 and 1930-2100, MDT. Total hours: 12.6. Census: Rufous-sided Towhee, 3 (195, 79); Black-billed Magpie, 2; Chipping Sparrow, 1. Total: 3 species; 6 territorial males or females (390/km², 158/100 acres). Visitors: Am. Kestrel, Mourning Dove, Com. Nighthawk, Com. Flicker, Am. Robin, Field Sparrow. Remarks: Nests located: Black-billed Magpie, 2. In addition, 5 or 6 Black-billed Magpie young were seen. This coulee lies within Theodore Roosevelt Nat'l Park (South Unit). Thanks to Farron Wallace for assistance in censusing.—**RICK HOPKINS and MICHAEL D. SCHWARTZ**, Zoology Dept., N.D. State Univ., Fargo, N.D. 58105.

Appendix II

Fall Bird Observations, 1978-1979^a

	Cottonwood Forest			Mixed Hardwood Patches			Juniper Patches			Pine Forest			Prairie		
	47 A.	32 A.		Ash-Cottonwood	Ash-Elm		Juniper	Juniper	Mixed Grass	50 A.	10 A.	10 A.	10 A.		
	78	79	78	78	79	78	78	79	78	79	78	79	78	79	
Red-tailed Hawk	X														
Sharp-tailed Grouse															
Ring-necked Pheasant		X													
Turkey															
Great Horned Owl	X														
Common Flicker	X														
Hairy Woodpecker		X													
Downy Woodpecker		X													
Black-billed Magpie	X	X													
Black-capped Chickadee	X	X													
White-breasted Nuthatch	X	X													
Red-breasted Nuthatch															
Rock Wren															
American Robin															
Golden-crowned Kinglet		X													
Tennessee Warbler															
Magnolia Warbler															
Yellow-rumped Warbler															
Bay-breasted Warbler															
Western Meadowlark															
Pine Siskin															
Red Crossbill															
Rufous-sided Towhee	X														
Dark-eyed Junco	X	X													
Tree Sparrow															
Chipping Sparrow															
Field Sparrow															
White-throated Sparrow															

^a 1978 visits from September 26 to October 19.
1979 visits from October 15 to October 18.



Common and Scientific Name of Birds

Cooper's Hawk	<i>Accipiter cooperii</i>	Breeding ^a
Red-tailed Hawk	<i>Buteo jamaicensis</i>	Breeding
Swainson's Hawk	<i>Buteo Swainsoni</i>	Breeding
Rough-legged Hawk	<i>Buteo lagopus</i>	Resident
Marsh Hawk	<i>Circus cyaneus</i>	Breeding
Prairie Falcon	<i>Falco mexicanus</i>	Breeding
Merlin	<i>Falco columbarius</i>	Breeding
American Kestrel	<i>Falco sparverius</i>	Breeding
Sharp-tailed Grouse	<i>Pedioecetes phasianellus</i>	Resident
Ring-necked Pheasant	<i>Phasianus colchicus</i>	Resident
Wild Turkey	<i>Meleagris gallopavo</i>	Resident
Killdeer	<i>Charadrius vociferus</i>	Breeding
Long-billed Curlew	<i>Numenius americanus</i>	Breeding
Upland Sandpiper	<i>Bartramia longicauda</i>	Breeding
Mourning Dove	<i>Zenaida macroura</i>	Breeding
Great Horned Owl	<i>Bubo virginianus</i>	Resident
Long-eared Owl	<i>Asio otus</i>	Resident
Common Flicker	<i>Colaptes auratus</i>	Breeding
Red-headed Woodpecker	<i>Melanerpes erythrocephalus</i>	Breeding
Hairy Woodpecker	<i>Picoides villosus</i>	Resident
Downy Woodpecker	<i>Picoides pubescens</i>	Resident
Eastern Kingbird	<i>Tyrannus tyrannus</i>	Breeding
Western Wood Pewee	<i>Contopus sordidulus</i>	Breeding
Horned Lark	<i>Eremophila alpestris</i>	Resident
Blue Jay	<i>Cyanocitta cristata</i>	Resident
Black-billed Magpie	<i>Pica pica</i>	Resident
Common Crow	<i>Corvus brachyrhynchos</i>	Breeding
Black-capped Chickadee	<i>Parus atricapillus</i>	Resident
White-breasted Nuthatch	<i>Sitta carolinensis</i>	Resident
Red-breasted Nuthatch	<i>Sitta canadensis</i>	Resident
House Wren	<i>Troglodytes aedon</i>	Breeding
Gray Catbird	<i>Dumetella carolinensis</i>	Breeding
Brown Thrasher	<i>Toxostoma rufum</i>	Breeding
American Robin	<i>Turdus migratorius</i>	Resident
Swainson's Thrush	<i>Catharus ustulatus</i>	Transient
Gray-cheeked Thrush	<i>Catharus minimus</i>	Transient
Mountain Bluebird	<i>Sialia currucoides</i>	Breeding
Townsend's Solitaire	<i>Myadestes townsendi</i>	rare
Bohemian Waxwing	<i>Bombucilla jarrulus</i>	Resident
Cedar Waxwing	<i>Bombucilla cedrorum</i>	Resident
Starling	<i>Sturnus vulgaris</i>	Resident
Solitary Vireo	<i>Vireo solitarius</i>	Transient
Red-eyed Vireo	<i>Vireo olivaceus</i>	Breeding
Philadelphia Vireo	<i>Vireo philadelphicus</i>	Transient
Warbling Vireo	<i>Vireo gilvus</i>	Breeding
Black-and-white Warbler	<i>Mniotilta varia</i>	Breeding
Tennessee Warbler	<i>Vermivora peregrina</i>	Transient

^a Residency Status



Appendix III - Common & Scientific Name of Birds

Orange-crowned Warbler	<i>Vermivora celata</i>	Transient
Nashville Warbler	<i>Vermivora ruficapilla</i>	Transient
Yellow Warbler	<i>Dendroica petechia</i>	Breeding
Yellow-rumped Warbler (Myrtle or Audubon's)	<i>Dendroica coronata</i>	Transient or Breeding
Blackpoll Warbler	<i>Dendroica striata</i>	Transient
Palm Warbler	<i>Dendroica palmarum</i>	Transient
Ovenbird	<i>Seiurus aurocapillus</i>	Breeding
Mourning Warbler	<i>Oporornis philadelphica</i>	Transient
Common Yellowthroat	<i>Geothlypis trichas</i>	Breeding
Yellow-breasted Chat	<i>Icteria virens</i>	Breeding
Canada Warbler	<i>Wilsonia canadensis</i>	Transient
American Redstart	<i>Setophaga ruticilla</i>	Breeding
House Sparrow	<i>Passer domesticus</i>	Resident
Western Meadowlark	<i>Sturnella neglecta</i>	Breeding
Red-winged Blackbird	<i>Agelaius phoeniceus</i>	Breeding
Northern Oriole	<i>Icterus galbula</i>	Breeding
Common Grackle	<i>Quiscalus quiscula</i>	Breeding
Brewer's Blackbird	<i>Euphagus cyanocephalus</i>	Breeding
Brown-headed Cowbird	<i>Molothrus ater</i>	Breeding
Rose-breasted Grosbeak	<i>Pheucticus ludovicianus</i>	Transient
Black-headed Grosbeak	<i>Pheucticus melanocephalus</i>	Breeding
Lazuli Bunting	<i>Passerina amoena</i>	Breeding
American Goldfinch	<i>Spinus tristis</i>	Breeding
Red Crossbill	<i>Loxia curvirostra</i>	Resident
Rufous-sided Towhee	<i>Pipila erythrophthalmus</i>	Breeding
Savannah Sparrow	<i>Passerculus sandwichensis</i>	Breeding
Baird's Sparrow	<i>Ammodramus bairdii</i>	Breeding
Vesper Sparrow	<i>Poocetes gramineus</i>	Breeding
Lark Sparrow	<i>Chondestes grammacus</i>	Resident
Dark-eyed Junco	<i>Junco hyemalis</i>	Transient
Tree Sparrow	<i>Spizella arborea</i>	Transient
Chipping Sparrow	<i>Spizella passerina</i>	Breeding
Clay-colored Sparrow	<i>Spizella pallida</i>	Breeding
Field Sparrow	<i>Spizella pusilla</i>	Breeding
Harris Sparrow	<i>Zonotrichia querula</i>	Transient
White-crowned Sparrow	<i>Zonotrichia leucophrys</i>	Transient
White-throated Sparrow	<i>Zonotrichia albicollis</i>	Transient
Fox Sparrow	<i>Passerella iliaca</i>	Transient
Lincoln's Sparrow	<i>Melospiza lincolni</i>	Transient
Song Sparrow	<i>Melospiza melodia</i>	Breeding

Common and Scientific Names of Mammals

Eastern Cottontail	<i>Sylvilagus floridanus</i>
Desert Cottontail	<i>Sylvilagus auduboni</i>
Least Chipmunk	<i>Eutamias minimus</i>
Thirteen-lined Ground Squirrel	<i>Spermophilus tridecemlineatus</i>
Fox Squirrel	<i>Sciurus niger</i>
Northern Pocket Gopher	<i>Thomomys talpoides</i>
Deer Mouse	<i>Peromyscus maniculatus</i>
White-footed Mouse	<i>Peromyscus leucopus</i>
Meadow Vole	<i>Microtus pennsylvanicus</i>
Prairie Vole	<i>Microtus ochrogaster</i>
Porcupine	<i>Erethizon dorsatum</i>
Coyote	<i>Canis latrans</i>
Mule Deer	<i>Odocoileus hemionus</i>
Whitetail Deer	<i>Odocoileus virginianus</i>
Pronghorn	<i>Antilocapra americana</i>
Bison	<i>Bison bison</i>
Mountain Sheep	<i>Ovis canadensis</i>