SEASONAL ANALYSIS OF A SOUTHWESTERN NEW MEXICO RIPARIAN BIRD COMMUNITY

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The lower Gila River Valley of southwestern New Mexico has some of the finest riparian habitat and the most diverse association of wildlife to be found in the entire lower Colorado River drainage (Zimmerman 1970, 1975; Hubbard 1971; Johnson et al. 1974). Over two-thirds of New Mexico's total of 449 species of birds are known from the valley (Zimmerman 1975, Hubbard 1977). In addition, the New Mexico portion of the Gila River Valley contains the greatest diversity of raptors in the lower Colorado River drainage and the largest number of endangered, threatened and peripheral bird species (Johnson et al. 1974). The present study was conducted to examine and quantify seasonal changes in avian composition, density and diversity along the Gila River. Comparisons of the present study with similar studies indicate numerous similarities, but the results reaffirm the richness of the avifauna in the New Mexico portion of the Gila River Valley.

METHODS

I established twenty contiguous study plots along the Gila River on the northeast side of the U.S. Highway 180 bridge (T15S, R17W, Sec. 33 & T16S, R17W, Sec. 4) in Grant County, New Mexico. Two types of habitat were recognized and subdivided accordingly: sandy riverbottom (5.30 ha) and adjacent woodlands (9.15 ha) composed of Fremont's Cottonwood (*Populus fremontii*), Box-elder (*Acer negundo*), and Goodding's Willow (*Salix gooddingii*) stands (see Figures 1 & 2). Twenty-three weekly surveys were made between 4 January and 30 June 1975. Surveys were conducted according to methods outlined under the heading "Winter Bird-Population Study" in *Audubon Field Notes* (Anonymous 1950). The spot-map method (Williams 1936, Kendeigh 1944) was used in conjunction with the former methods to estimate breeding bird populations during May and June. Densities and size classes of trees in the wooded stands were measured during winter months by direct counts and checked against low-altitude aerial photographs. No effort was made to measure vegetation in the riverbottom because there was virtually no terrestrial and very little aquatic vegetation.

Species diversity was calculated using the Shannon-Weaver (1949) information function,

$$H^1 = -\sum_{i=1}^{S} p_i \ln p_i$$

where S is the number of species, and p_i is the proportion of the total number of individuals consisting of the ith species. This measure (H^1) has two separate components, species richness (S) and the equitability or evenness of species abundance (Lloyd and Ghelardi 1964, Tramer 1969). Species

richness is simply the number of species in the sample. To measure the evenness of abundance, I used the index $J^1 = H^1/H^1$ max in which H^1 max is ln S. This index represents the ratio of the observed diversity to the maximum diversity possible for the same number of species. It has a maximum value of one when all species are equally abundant.

AREA DESCRIPTION

The study area is at an elevation of 1370 m and was the largest single stand of riparian woodland in the immediate vicinity. Surrounding areas included abandoned farm land to the west, farmed land to the east, and land similar to that of the study area to the north and south. Box-elder, cottonwood and willow trees within the study area produced a combined canopy cover of approximately 80%, excluding the riverbottom and two small open areas. Box-elders attained heights up to 15 m, average densities of 41 trees per ha (excluding saplings, which averaged 102 per ha), and DBH (diameter at breast height) values from 26 to 64 cm (based on pooled averages from each of the 12 wooded study plots). Fremont's Cottonwoods reached heights of 27 m, average densities of 14 trees per ha (virtually no saplings), and DBH values from 36 to 128 cm. Goodding's Willow stands attained heights of 12 m, average densities of 11 trees per ha, and DBH values from 29 to 47 cm. Cottonwoods and willows were well dispersed throughout the area, as were Box-elders, but the latter tended to be somewhat more concentrated in

Figure 1. Panoramic view of a portion of the Gila River Valley study area looking south; area of study includes both the open sandy riverbottom in the foreground and densely wooded areas in the background.

southern portions of the study area. Small stands of Emory Baccharis (*Baccharis emoryi*) in southern portions of the study area were replaced in the more northern plots by Seepwillow (*Baccharis glutinosa*). The dense understory was also composed of fallen limbs, snags and the following plants: Chuchupate (*Ligusticum porteri*), Buffaloweed (*Ambrosia trifida*), Sweet Four-O'Clock (*Mirabilis longiflora*), Skunk-bush (*Rhus trilobata*), and Western Virginia-Creeper (*Parthenocissus inserta*).

RESULTS

Species Composition and Seasonal Occurrence. Each of the 112 bird species observed during the study was grouped into one of four categories based on its seasonal occurrence and breeding status (Table 1). The four categories are: (1) winter birds (30 species), those present during January and February but not remaining to breed; (2) migrants (29 species), those present during months other than January and February but not remaining to breed; (3) summer residents (24 species), those not members of the former categories but nesting or using the area extensively during May and June; and (4) permanent residents (29 species), birds generally present throughout the 6-month period.

Of the 30 winter species, only the Red-tailed Hawk, Brown Creeper, Ruby-crowned Kinglet, Yellow-rumped Warbler, Rufous-sided Towhee, Song Sparrow, Lincoln's Sparrow, White-crowned Sparrow and Dark-eyed Junco were consistently present. Others such as Green-winged Teal, Northern Pintail, Northern Harrier, Golden Eagle, Prairie Falcon, Bushtit,

Figure 2. Typical view of Gila River Valley wooded areas showing Goodding's Willows in the foreground with Box-elders and Fremont's Cottonwoods in the background.

Western Bluebird and Loggerhead Shrike were recorded within the area only once, although most were present in nearby areas throughout much of the period. The one Ring-billed Gull was merely a vagrant to the study area; the species is irregular in the lower Gila River Valley. The single Hermit Thrush observed on the first of February may have wintered in nearby habitats.

Very few of the 29 migrant species remained for an extended period. Those lingering included Wilson's Warbler, House Wren and Chipping Sparrow. Most of the remaining species were simply present one week and were gone by the next. Some, such as Broad-tailed Hummingbird, Painted Redstart, Western Tanager and Green-tailed Towhee, were common in other, generally more elevated, areas of the lower Gila River Valley during late spring and summer. Say's Phoebe and Chihuahuan Raven were relatively common in open habitats adjacent to the study area but rarely ventured into the area itself. The Gray Flycatcher is a regular migrant in this area of New Mexico, but it is more typical of evergreen woodlands (John Hubbard in litt.). The Winter Wren and American Redstart are uncommon in the area but nonetheless may occur somewhat regularly in very low numbers.

Most of the 24 summer species were continuously present after their initial arrival and all but three nested within the study area. Turkey Vultures and Cooper's Hawks occasionally entered the study area but I obtained no evidence of nesting. The single American Crow observed in late May and early June was probably a vagrant, since the species was uncommon throughout the lower Gila River Valley prior to 1975. It has, however, become more common in the Valley during the past decade (Dale Zimmerman in litt.). The extended presence of Cliff Swallows resulted from the establishment of a nesting colony under the U.S. Highway 180 bridge, which formed the southern boundary of the study.

Only six of the 29 permanent residents were observed on each of the 23 weekly surveys. All but two, however, were observed on 50% or more of the surveys. Despite the fact that Brown Towhees and Western Meadowlarks only occasionally entered the study area, I considered them residents because they were consistently seen and/or heard throughout the study in adjacent areas. The Great Blue Heron, Mallard, Common Merganser, Spotted Sandpiper, Ladder-backed Woodpecker, Common Raven, Brown Towhee and Western Meadowlark did not nest within the confines of the study area, but all presumably nested in adjacent areas. Common Ravens are, however, known to have nested within the area during other years (Dale Zimmerman in litt.). The remaining 21 permanent residents are known to have nested within the study area during the course of my study (Table 1).

Seasonal Variability. Variability in avian density, species richness, equitability, and bird species diversity in each habitat type are shown in Table 2. Avian density within riverbottom areas showed considerable monthly variation; there was less variation within the wooded areas. Seasonal density patterns within both riverbottom and wooded habitats showed expected seasonal trends; i.e., numbers were lowest during winter, highest during spring migration, and of intermediate magnitude during the breeding season. The number of species present throughout the entire 6-month period in riverbottom areas remained relatively constant, whereas that for wooded areas showed expected seasonal fluctuations.

Table 1. Status, period and frequency of occurrence, and monthly density of birds censused in the lower Gila River Valley, southwestern New Mexico. See text for definition of winter birds (W), migrants (M), summer residents (S) and permanent residents (P). An asterisk (*) indicates species that nested in the study area.

Species	Status	First and last date of occurrence	Frequency of occurrence (%)	Monthly density (avg. no. individuals/40 ha) Jan	Feb	Mar	Apr	May	Jun
Great Blue Heron *Ardea herodias*	P	4 Jan-15 Jun	56.5	11	10	15	8	8	8
Green-winged Teal *Anas crecca*	W	15 Feb-15 Feb	4.3		38				
Mallard *Anas platyrhynchos*	P	4 Jan-1 Jun	78.3	79	38	70	47	15	8
Northern Pintail *Anas acuta*	W	15 Feb-15 Feb	4.3		15				
Cinnamon Teal *Anas cyanoptera*	M	10 Mar-10 Mar	4.3			15			
Common Merganser *Mergus merganser*	P	18 Jan-1 Jun	56.5	23	17	28	20		8
Turkey Vulture *Cathartes aura*	S	22 Mar-30 Jun	39.1			4	9	7	4
Bald Eagle *Haliaeetus leucocephalus*	W	11 Jan-18 Jan	8.7	4					
Northern Harrier *Circus cyaneus*	W	15 Feb-15 Feb	4.3		4				
Sharp-shinned Hawk *Accipiter striatus*	W	25 Jan-29 Mar	8.7	4		4			
Cooper's Hawk *Accipiter cooperii*	S	26 Apr-1 Jun	8.7				4		9
Common Black-Hawk *Buteogallus anthracinus*	S*	10 Mar-30 Jun	65.2			9	9	9	9

Table 1 (Cont.)

Species	Status	First and last date of occurrence	Frequency of occurrence (%)	Monthly density (avg. no. individuals/40 ha) Jan	Feb	Mar	Apr	May	Jun
Red-tailed Hawk *Buteo jamaicensis*	W	4 Jan-26 Apr	43.5	6	4	4	4		
Golden Eagle *Aquila chrysaetos*	W	1 Feb-1 Feb	4.3		4				
American Kestrel *Falco sparverius*	P*	10 Feb-30 Jun	69.6		4	8	10	26	18
Prairie Falcon *Falco mexicanus*	W	25 Jan-25 Jan	4.3	4					
Ring-necked Pheasant *Phasianus colchicus*	P*	4 Jan-24 Jun	56.5	4	4	9	18	7	22
Gambel's Quail *Callipepla gambelii*	P*	25 Jan-30 Jun	56.5	131		35	18	18	18
Sandhill Crane *Grus canadensis*	W	18 Jan-10 Mar	13.0	13	105	26			
Killdeer *Charadrius vociferus*	P*	4 Jan-30 Jun	95.7	47	17	15	13	10	15
Solitary Sandpiper *Tringa solitaria*	M	3 May-3 May	4.3					8	
Spotted Sandpiper *Actitis macularia*	P	11 Jan-3 May	56.5	8	8	9	10	15	
Least Sandpiper Calidris minutilla	W	4 Jan-20 Apr	13.0	8			8		
Common Snipe *Gallinago gallinago*	W	4 Jan-5 Apr	17.4	50			8		
Ring-billed Gull Larus delawarensis	W	22 Feb-22 Feb	4.3		8				

White-winged Dove *Zenaida asiatica*	M	12 May-12May	4.3					4	
Mourning Dove *Zenaida macroura*	P*	4 Jan-30 Jun	100.0	59	89	48	73	109	93
Yellow-billed Cuckoo *Coccyzus americanus*	S*	1 Jun-15 Jun	8.7						11
Great Horned Owl *Bubo virginianus*	P*	10 Feb-30 Jun	56.5		7	4	4	13	16
White-throated Swift *Aeronautes saxatalis*	M	22 Mar-22 Mar	4.3			45			
Black-chinned Hummingbird *Archilochus alexandri*	S*	12 Apr-30 Jun	39.1				7	18	18
Broad-tailed Hummingbird *Selasphorus platycercus*	M	12 Apr-26 Apr	8.7				9		
Belted Kingfisher *Ceryle alcyon*	P*	4 Jan-30 Jun	52.2	13	8	11	13	15	15
Acorn Woodpecker *Melanerpes formicivorus*	P*	10 Feb-30 Jun	78.3		7	7	8	9	9
Gila Woodpecker *Melanerpes uropygialis*	P*	11 Jan-30 Jun	65.2	9	4	9	7	18	18
Red-naped Sapsucker *Sphyrapicus nuchalis*	W	4 Jan-22 Mar	17.4	4	4	4			
Ladder-backed Woodpecker *Picoides scalaris*	P	4 Jan-3 May	69.6	11	7	8	7	9	
Hairy Woodpecker *Picoides villosus*	P*	4 Jan-30 Jun	87.0	7	7	7	6	9	9
Northern Flicker *Colaptes auratus*	P*	4 Jan-30 Jun	100.0	11	15	16	12	26	26
Western Wood-Pewee *Contopus sordidulus*	S*	3 May-30 Jun	30.4					39	26
Gray Flycatcher *Empidonax wrightii*	M	26 Apr-12 May	13.0				4	13	

Table 1 (Cont.)

Species	Status	First and last date of occurrence	Frequency of occurrence (%)	Monthly density (avg. no. individuals/40 ha) Jan	Feb	Mar	Apr	May	Jun
Western Flycatcher *Empidonax difficilis*	M	12 May-23 May	8.7					7	
Black Phoebe *Sayornis nigricans*	P*	4 Jan-30 Jun	95.7	15	13	15	21	45	45
Eastern Phoebe *Sayornis phoebe*	W	18 Jan-25 Jan	8.7	4					
Say's Phoebe *Sayornis saya*	M	12 Apr-12 Apr	4.3				4		
Vermilion Flycatcher *Pyrocephalus rubinus*	S*	15 Mar-30 Jun	34.8			7	9	9	9
Ash-throated Flycatcher *Myiarchus cinerascens*	S*	26 Apr-30 Jun	34.8				9	9	9
Cassin's Kingbird *Tyrannus vociferans*	S*	3 May-30 Jun	30.4					18	18
Western Kingbird *Tyrannus verticalis*	S*	20 Apr-15 Jun	17.4				9	18	9
Violet-green Swallow *Tachycineta thalassina*	M	26 Apr-23 May	8.7				377	91	
Northern Rough-winged Swallow *Stelgidopteryx serripennis*	S*	10 Mar-24 Jun	43.5			15	60	60	60
Cliff Swallow *Hirundo pyrrhonota*	S*	12 Apr-30 Jun	43.5				359	755	377
American Crow *Corvus brachyrhynchos*	S	12 May-1 Jun	13.0					4	4
Chihuahuan Raven *Corvus cryptoleucus*	M	12 Apr-12 Apr	4.3				9		

Common Raven *Corvus corax*	P	18 Jan-23 May	65.2	9	7	15	12	26	
Bridled Titmouse *Parus wollweberi*	P*	4 Jan-1 Jun	87.0	40	35	38	23	44	44
Bushtit *Psaltriparus minimus*	W	18 Jan-18 Jan	4.3	87					
White-breasted Nuthatch *Sitta carolinensis*	P*	4 Jan-30 Jun	100.0	26	19	10	16	44	44
Brown Creeper *Certhia americana*	W	4 Jan-29 Mar	34.8	7	18	8			
Bewick's Wren *Thryomanes bewickii*	P*	4 Jan-30 Jun	100.0	63	37	45	34	61	87
House Wren *Troglodytes aedon*	M	20 Apr-23 May	21.7				11	7	
Winter Wren *Troglodytes troglodytes*	M	10 Mar-20 Apr	13.0			4	4		
Marsh Wren *Cistothorus palustris*	M	29 Mar-26 Apr	13.0			4	4		
Ruby-crowned Kinglet *Regulus calendula*	W	4 Jan-12 Apr	60.9	63	37	26	35		
Western Bluebird *Sialia mexicana*	W	4 Jan-4 Jan	4.3	18					
Swainson's Thrush *Catharus ustulatus*	M	12 May-12 May	4.3					4	
Hermit Thrush *Catharus guttatus*	W	1 Feb-1 Feb	4.3		4				
American Robin *Turdus migratorius*	P*	4 Jan-30 Jun	100.0	14	43	40	27	26	26
Water Pipit *Anthus spinoletta*	W	4 Jan-12 Apr	21.7	43			8		
Loggerhead Shrike *Lanius ludovicianus*	W	4 Jan-4 Jan	4.3	4					

Table 1 (Cont.)

Species	Status	First and last date of occurrence	Frequency of occurrence (%)	Monthly density (avg. no. individuals/40 ha) Jan	Feb	Mar	Apr	May	Jun
European Starling *Sturnus vulgaris*	P*	4 Jan-30 Jun	100.0	18	25	39	24	79	55
Solitary Vireo *Vireo solitarius*	M	3 May-3 May	4.3					35	
Warbling Vireo *Vireo gilvus*	S*	26 Apr-15 Jun	17.4				4	9	9
Virginia's Warbler *Vermivora virginiae*	M	26 Apr-26 Apr	4.3				48		
Lucy's Warbler *Vermivora luciae*	S*	29 Mar-30 Jun	34.8			4	39	18	18
Yellow Warbler *Dendroica petechia*	S*	5 Apr-30 Jun	47.8				42	76	86
Yellow-rumped Warbler *Dendroica coronata*	W	4 Jan-3 May	73.9	13	15	28	137	74	
Black-throated Gray Warbler *Dendroica nigrescens*	M	12 Apr-12 Apr	4.3				9		
Townsend's Warbler *Dendroica townsendi*	M	26 Apr-26 Apr	4.3				26		
American Redstart *Setophaga ruticilla*	M	12 May-12 May	4.3					4	
Northern Waterthrush *Seiurus noveboracensis*	M	3 May-12 May	8.7					4	
Common Yellowthroat *Geothlypis trichas*	S*	29 Mar-24 Jun	43.5			13	46	51	44
Wilson's Warbler *Wilsonia pusilla*	M	12 Apr-23 May	26.1				86	41	

Painted Redstart *Myioborus pictus*	M	22 Mar-3 May	13.0			4	4	4	
Yellow-breasted Chat *Icteria virens*	S*	3 May-30 Jun	30.4					35	35
Summer Tanager *Piranga rubra*	S*	26 Apr-30 Jun	34.8				18	26	26
Western Tanager *Piranga ludoviciana*	M	26 Apr-3 May	8.7				4	22	
Northern Cardinal *Cardinalis cardinalis*	P*	4 Jan-24 Jun	91.3	8	9	12	9	18	18
Black-headed Grosbeak *Pheucticus melanocephalus*	S*	20 Apr-30 Jun	39.1				7	18	18
Blue Grosbeak *Guiraca caerulea*	S*	23 May-30 Jun	21.7					44	18
Lazuli Bunting *Passerina amoena*	M	12 Apr-20 Apr	8.7				15		
Green-tailed Towhee *Pipilo chlorurus*	M	20 Apr-3 May	13.0				4	4	
Rufous-sided Towhee *Pipilo erythrophthalmus*	W	4 Jan-29 Mar	43.5	10	6	6			
Brown Towhee *Pipilo fuscus*	P	18 Jan-1 Jun	17.4	4	4		4		9
Abert's Towhee *Pipilo aberti*	P*	11 Jan-30 Jun	82.6	9	8	8	7	18	18
Chipping Sparrow *Spizella passerina*	M	22 Mar-20 Apr	17.4			18	7		
Song Sparrow *Melospiza melodia*	W	4 Jan-3 May	69.6	50	37	15	10	4	
Lincoln's Sparrow *Melospiza lincolnii*	W	4 Jan-12 May	69.6	16	9	6	9	18	
Swamp Sparrow *Melospiza georgiana*	W	11 Jan-26 Apr	17.4	9	9	4	4		

Table 1 (Cont.)

Species	Status	First and last date of occurrence	Frequency of occurrence (%)	Monthly density (avg. no. individuals/40 ha) Jan	Feb	Mar	Apr	May	Jun
White-throated Sparrow *Zonotrichia albicollis*	M	15 Mar-12 Apr	13.0			9	13		
White-crowned Sparrow *Zonotrichia leucophrys*	W	11 Jan-12 May	65.2	11	30	77	71	26	
Dark-eyed Junco *Junco hyemalis*	W	4 Jan-20 Apr	60.9	148	79	38	39		
Red-winged Blackbird *Agelaius phoeniceus*	P*	4 Jan-30 Jun	73.9	147	480	91	33	27	30
Western Meadowlark *Sturnella neglecta*	P	4 Jan-24 Jun	21.7	22	18				20
Brewer's Blackbird *Euphagus cyanocephalus*	W	4 Jan-1 Feb	17.4	63	53				
Great-tailed Grackle *Quiscalus mexicanus*	M	30 Jun-30 Jun	4.3						4
Brown-headed Cowbird *Molothrus ater*	S*	20 Apr-30 Jun	39.1				9	20	43
Northern Oriole *Icterus galbula*	S*	20 Apr-15 Jun	26.1				4	9	9
House Finch *Carpodacus mexicanus*	P*	11 Jan-30 Jun	95.7	23	23	22	22	26	53
Pine Siskin *Carduelis pinus*	M	22 Mar-5 Apr	8.7				70	44	
Lesser Goldfinch *Carduelis psaltria*	S*	22 Mar-30 Jun	30.4			9	4	22	50
American Goldfinch *Carduelis tristis*	W	11 Jan-12 Apr	26.1	4	4	37	4		

Equitability for species confined primarily to riverbottom areas was fairly uniform throughout winter and spring months, but in May and June it averaged lower than in earlier months. Equitability for species associated with wooded areas was surprisingly constant throughout the 6-month period.

Species diversity for those birds primarily of riverbottom areas was generally similar throughout winter and early spring months, but declined in May and June. In wooded areas diversity was lowest in January, steadily increased from February through May, and declined slightly in June.

Numbers of birds per 40 ha and the corresponding components of species diversity for each month based on the data in Table 1 (for which no habitat distinctions were made) are shown in Table 3. Density values for the entire study area also showed expected seasonal trends, i.e., numbers were stable during January and February, declined slightly in March, peaked in April and May, and declined again in June. The number of species present each month showed a similar trend, but without a decline in March. Equitability during

Table 2. Seasonal variability in avian density, species richness, equitability, and diversity. Values shown for each habitat type, month, and measure are the mean, standard deviation, and range.

	January	February	March	April	May	June
Riverbottom (5.30 ha)						
	53.5	59.8	32.0	71.8	129.0	81.0
Density	21.3	73.9	7.6	53.7	5.6	26.1
	28-79	11-168	24-42	24-125	123-134	70-120
	8.5	6.5	7.8	8.8	7.7	5.3
Species richness	1.3	2.1	1.5	1.7	1.2	1.3
	7-10	4-9	6-9	7-11	7-9	4-7
	0.76	0.61	0.75	0.69	0.44	0.52
Equitability	0.08	0.32	0.12	0.23	0.05	0.11
	0.65-0.77	0.25-0.92	0.59-0.85	0.38-0.89	0.39-0.49	0.35-0.60
	1.62	1.04	1.53	1.48	0.89	0.82
Species diversity	0.26	0.47	0.34	0.49	0.11	0.11
	1.27-1.87	0.54-1.64	1.06-1.88	0.80-1.96	0.76-0.96	0.67-0.93
Woodland (9.15 ha)						
	168.3	140.3	144.5	201.0	257.7	219.8
Density	55.3	12.9	38.2	54.3	28.2	14.4
	127-249	124-152	113-200	133-256	238-290	209-240
	25.8	26.3	30.5	39.3	40.3	31.8
Species richness	2.4	0.5	1.9	6.5	4.5	3.1
	24-29	26-27	28-32	30-45	36-45	29-36
	0.82	0.85	0.89	0.85	0.91	0.92
Equitability	0.04	0.03	0.02	0.04	0.01	0.01
	0.77-0.87	0.82-0.89	0.87-0.91	0.82-0.91	0.90-0.95	0.91-0.93
	2.68	2.78	3.03	3.09	3.36	3.16
Species diversity	0.20	0.10	0.05	0.02	0.13	0.07
	2.46-2.85	2.75-2.91	2.97-3.08	3.08-3.11	3.24-3.50	3.09-3.26

Table 3. Monthly variability in density (no./40 ha), species richness, equitability, and diversity for the entire study area.

Month	Density	Species richness	Equitability	Species diversity
January	1454	50	0.86	3.35
February	1446	48	0.75	2.91
March	1077	55	0.90	3.62
April	2199	77	0.79	3.42
May	2409	67	0.78	3.26
June	1655	51	0.85	3.33

the 6-month period remained relatively high, with little variation (s.d. = 0.06). Species diversity throughout the period was also high and showed only moderate variability (s.d. = 0.24).

DISCUSSION

Patterns of community relationships often differ substantially from season to season and annual variation is also common (Anderson et al. 1981). Bird communities in particular often undergo conspicuous seasonal changes that produce alterations in population levels and species composition. Temporal variation is influenced by changes in environmental conditions, food resources, or habitat structure (Raitt and Pimm 1976, Rotenberry and Weins 1980, Karr and Freemark 1983, Blake 1984).

Factors determining the presence and abundance of species during winter months were not investigated, nor were such factors studied during spring and summer months. Nonetheless, my study demonstrates that the lower Gila River Valley provides important wintering habitat for numerous species. At least 59 bird species are known to have utilized the study area during winter. This is in stark contrast to other habitat types (Cink and Boyd 1984), which support only a fraction of the bird species wintering in the lower Gila River Valley.

Migrating passerines are known to show a decided preference for riparian over nonriparian habitats (Stevens et al. 1977). The availability of food, water and cover provided by these areas undoubtedly is important and strongly influences migrant distribution and abundance. The characteristic northbound and southbound bird movement along major waterways is common elsewhere, but river corridors are perhaps even more important to migrating birds in arid parts of the country than in humid, heavily vegetated regions (Wauer 1977).

The use of the lower Gila River Valley as a migration corridor is clearly exemplified by the presence of the many non-breeding land birds. The concentration of migrants here undoubtedly plays a key role in maximizing bird species diversity during this period, and demonstrates the importance of the Gila River Valley to migrating land birds.

Previous studies in southwestern riparian habitats have shown over 50% of the bird species occupying river valleys during the breeding season to be

exclusively dependent upon the gallery forest vegetation type (Carothers et al. 1982). Of the 112 species shown in Table 1, 42 nested within the confines of the study area, and all but 28 of the remaining species are known to breed in other portions of the Gila River Valley (Hubbard 1971, Baltosser 1975).

Breeding bird density for riverbottom habitat was 364 pairs per 40 ha and that for the wooded habitat was 512 pairs per 40 ha. Cliff Swallows, equally abundant in other portions of the Gila River Valley, were by far the most numerous species in the riverbottom. The Mourning Dove, Yellow Warbler, Bewick's Wren and European Starling were the most abundant species breeding in wooded areas.

Johnson et al. (1974), working approximately 11 km north of my study area, recorded 23 breeding species and approximately 310 pairs per 40 ha. He and his co-workers were unable to obtain precise population estimates for areas such as the cottonwood, Box-elder and willow stands of my area, but suggested populations of 620 pairs per 40 ha occurred in such areas and that the number of species was slightly higher. Zimmerman (1975) reported on three additional areas along the Gila River and estimated densities of 290, 650 and 750 pairs per 40 ha, with 39, 36 and 31 breeding species, respectively.

Seasonal fluctuations in the density of individual species reported by Anderson and Ohmart (1977) along the Colorado River show many values that approximate those for the same species in my study. Breeding densities of the present study are similar to other studies in the region, but the number of species contributing to these values was greater (i.e., 42 nesting species). Additional surveys conducted by Cole (1978) in the central Rio Grande Valley of New Mexico yielded an average of 508 pairs per 40 ha, with a maximum of 31 species at any one site. Carothers et al. (1974) estimated breeding densities along Arizona's Verde River to be from 425 to 847 pairs per 40 ha, with a maximum of 26 species at any one site. Stamp (1978) also conducted surveys along the Verde and found densities to be as high as 684 pairs per 40 ha, with a maximum of 30 species.

Riparian forests in arid portions of western North America have been shown to be of great ecological importance to bird populations (Carothers et al. 1974, Anderson and Ohmart 1977, Stamp 1978, Rosenberg et al. 1982). Several factors undoubtedly contribute to this, but perhaps one of the most significant with respect to the lower Gila River Valley is the fact that this portion of the river penetrates several distinct floristic and faunistic provinces. The mingling of these various elements, coupled with the climatic and topographic attributes of the area, undoubtedly exert a major influence. As a result, the lower Gila River Valley of New Mexico is especially noteworthy in terms of both species composition and diversity.

SUMMARY

Seasonal changes in avian composition, density and diversity were examined in the lower Gila River Valley of New Mexico throughout a 6-month period. The 112 bird species observed were grouped into four categories based on seasonal presence and breeding status. Thirty species were winter

residents or visitors, 29 were present only as migrants, 24 were summer residents or visitors, and 29 species were permanently resident. Fluctuations in avian density, species richness, equitability and species diversity in sandy riverbottom and adjacent woodland habitats, as well as for both areas combined, were documented. Seasonal changes in avian community structure showed that the area provided habitat for at least 59 species during the winter. The study area proved to be extremely important as a migration corridor, which helped to maximize species diversity during spring migration. Breeding bird density for the riverbottom habitat type was 364 pairs per 40 ha and that for the wooded habitat type was 512 pairs per 40 ha. Comparisons of the present study with similar studies in the region show numerous similarities, but the area is especially noteworthy because few river systems support so many species and individuals within such a limited area.

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Common Black Hawks *Sketch by Keith Hansen*