BREEDING BIRDS OF DESERT RIPARIAN HABITAT IN SOUTHERN NEVADA

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Few studies of bird populations have been undertaken in desert communities. Previous studies in North American warm deserts were conducted by Hutchinson and Hutchinson (1941, 1942), Robert (1967), and Sheppard (1968) in California; Hensley (1954) and Tainter (1965) in Arizona; Raitt and Maze (1968) in New Mexico; and Dixon (1959) in Texas. Davis (1963) and Webster (1964) censused desert areas in Mexico. No study has been conducted in the northern Mohave Desert.

Breeding bird populations of two mesquite habitats near Las Vegas, Clark County, Nevada, are reported here. Also presented is a preliminary consideration of bird species diversity in desert communities.

METHODS

Breeding bird populations were studied during 1968 and 1969 by censusing pairs, singing males, family groups, and nests; records were entered in a notebook or on mimeographed maps. Censuses were conducted nine times 5 March–15 August 1968 and seven times 28 February–19 June 1969, generally before 10:00, when activity was at its peak. In addition, supplementary data were gathered at least once per week in connection with an ecological study of the Verdin (*Auriparus flaviceps*). The breeding populations were considered to be the maximum number of pairs on the area at one time. Although weakly territorial species presented difficulties, repeated encounters with adults or the presence of fledglings on the area were indicative of breeding.

Bird species diversity (BSD) was calculated using the information-theoretical measure (H') of Shannon (1948) and the tables of Lloyd et al. (1968). Foliage profiles (fig. 1) for the dunes and bosque (see description of study area, beyond) were constructed by determining foliage surface area per volume of space as used by MacArthur et al. (1966). A composite profile was constructed from these data by assuming that the bosque contributed one-fifth and the dunes four-fifths to the total. The profiles were divided into horizontal layers and the proportion that each contributed to the whole was used to calculate foliage height diversity (FHD) using H'.

The point-centered quarter method of Cottam and Curtis (1956) was used to determine density of shrubs and trees. These data in conjunction with crown diameter, depth, and shape data were used to calculate foliage volume for each species. Crown shape was considered to be spherical, conical, or cylindrical. A total of 80 plants was sampled.

THE STUDY AREA

GENERAL

The study area, located on Sunset Road near the east end of McCarran International Airport in a section of Las Vegas known as Paradise Valley (elev. 2162 ft), is typical of the Mohave Desert where subsurface water is shallow. The topography is flat except for several fairly large sand dunes. A small arroyo runs along part of the north end of the area. The soil is sand, 2–4 ft deep, with some accumulation of organic litter beneath the larger vegetation. The study area is relatively undisturbed except for two horse trails and a small area where dumping has occurred. The surrounding area is similar but with a few homes. The climate is typical of hot arid desert.

In order to discuss homogeneous habitats, the study area was subdivided into two areas: bosque (43 acres) and dunes (207 acres). The arroyo (ca. five acres) was included with the dunes.

VEGETATION

The study area is part of the Desert Riparian Biotic Community as described by Bradley and Deacon (1967). The dominant plants are honey and screwbean mesquites (*Prosopis juliflora* and *P. pubescens*). The former dominates the dunes, forming scattered dense thickets; the latter dominates the bosque. A few large catclaws (*Acacia greggii*) are found on the dunes and in the arroyo. Other shrubs and trees on the study area include creosotebush (*Larrea divaricata*), saltbushes (*Atriplex canescens* and *A. confertifolia*), inkweed (*Suaeda sericea*), tamarisk (*Tamarix* sp.), boxthorn (*Lycium* sp.) and two large cottonwoods (*Populus fremontii*). Several species of annuals occur on the dunes. Mistletoe (*Phoradendron californicum*) grows commonly on the mesquites, especially on the dunes. Relative densities and relative foliage volumes of the important plant species are presented in table 1. Total foliage volume of plants taller than 3 ft was 387,886 ft^3 per acre (99.5 per cent screwbean mesquite) in the bosque and 6422 ft^3 per acre (61 per cent honey mesquite, 24 per cent catclaw, 13 per cent creosotebush) in the dunes. Density of plants taller than 3 ft was 225 plants per acre in the bosque and 18 per acre in the dunes.

RESULTS

Twenty species were found breeding on the study area during the two years (17 species in 1968, 16 in 1969, table 2). Inclusion of White-winged Dove, Roadrunner, Ladder-

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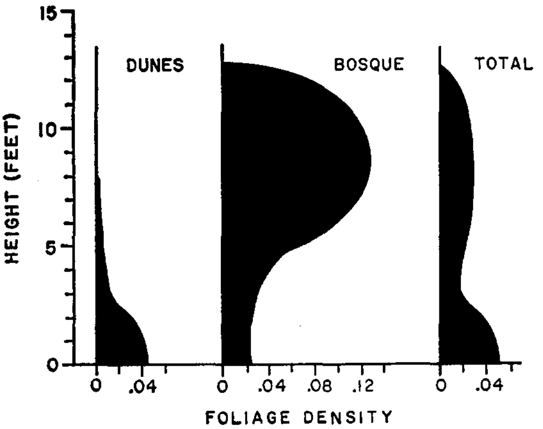

FIGURE 1. Foliage density (square feet of leaf silhouette per cubic foot of space) profiles of desert riparian habitat in southern Nevada.

backed Woodpecker, Brown-headed Cowbird, and House Finch as breeding birds was based on pairs present through the breeding season. Young of Roadrunner, Brown-headed Cowbird (being fed by Verdins), and House Finch were observed. Nests of the other species were located. Additional species known to breed in similar habitat in southern Nevada (pers. observ.) include Poor-will (*Phalaenoptilus nuttallii*), Costa's Hummingbird (*Calypte costae*), Western Kingbird (*Tyrannus verticalis*), LeConte's Thrasher (*Toxostoma lecontei*), and Loggerhead Shrike (*Lanius ludovicianus*).

TABLE 1. Relative density, volume, and use as a nest site of major plant species in southern Nevada.

Plant species	Relative density	Relative volume	Relative use as nest site
Screwbean mesquite	17.9	52.6	48.3
Honey mesquite	28.6	28.1	27.6
Catclaw	6.0	12.0	19.0
Creosotebush	38.1	6.3	0.0
Other	9.4	1.0	5.1
Total	100.0	100.0	100.0

Breeding densities of 31.5 and 44.0 pairs per 250 acres were found in 1968 and 1969, respectively (table 2). Populations in the dunes were considerably higher in 1969 than 1968; 60 nests of 15 species were located.

DISCUSSION

Raitt and Maze (1968) discussed the avifaunistic relationships of the warm North American deserts, including such factors as species composition, density, and diversity in relation to floristic composition and moisture availability. They demonstrated a curvilinear relationship between density (pairs/100 acres) and number of species in desert regions and attributed this to the availability of water affecting floristic composition, stature, and

TABLE 2. Breeding bird density (pairs) in desert riparian habitat in Southern Nevada.

Species	Dunes		Bosque		Total	
	1968	1969	1968	1969	1968	1969
Gambel's Quail (*Lophortyx gambelii*)	3.0	3.0	—	—	3.0	3.0
White-winged Dove (*Zenaida asiatica*)	—	—	—	0.5	—	0.5
Mourning Dove (*Zenaidura macroura*)	—	1.0	1.0	2.0	1.0	3.0
Roadrunner (*Geococcyx californianus*)	—	—	1.0	—	1.0	—
Lesser Nighthawk (*Chordeiles acutipennis*)	—	—	1.0	—	1.0	—
Ladder-backed Woodpecker (*Dendrocopos scalaris*)	—	—	0.5	—	0.5	—
Ash-throated Flycatcher (*Myiarchus cinerascens*)	—	1.0	—	—	—	1.0
Verdin (*Auriparus flaviceps*)	2.0	2.5	3.0	3.0	5.0	5.5
Bewick's Wren (*Thryomanes bewickii*)	0.5	0.5	1.5	2.0	2.0	2.5
Cactus Wren (*Campylorhynchus brunneicapillus*)	1.0	2.0	1.0	—	2.0	2.0
Mockingbird (*Mimus polyglottos*)	0.5	2.5	1.0	1.0	1.5	3.5
Crissal Thrasher (*Toxostoma dorsale*)	2.0	3.5	1.0	2.0	3.0	5.5
Black-tailed Gnatcatcher (*Polioptila melanura*)	—	1.0	1.0	1.0	1.0	2.0
Phainopepla (*Phainopepla nitens*)	3.0	4.0	1.5	—	4.5	4.0
Bell's Vireo (*Vireo bellii*)	—	—	1.0	—	1.0	—
Lucy's Warbler (*Vermivora luciae*)	—	—	1.0	2.0	1.0	2.0
Bullock's Oriole (*Icterus bullockii*)	—	1.0	1.0	1.5	1.0	2.5
Brown-headed Cowbird (*Molothrus ater*)	—	0.5	—	1.5	—	2.0
House Finch (*Carpodacus mexicanus*)	0.5	0.5	0.5	0.5	1.0	1.0
Abert's Towhee (*Pipilo aberti*)	—	—	2.0	4.0	2.0	4.0
Total species	8	13	16	12	17	16
Total pairs	12.5	23.0	19.0	21.0	31.5	44.0
Pairs/100 acres	6.0	11.1	44.3	48.9	12.6	17.6
Bird species diversity	1.860	2.346	2.671	2.335	2.447	2.634

TABLE 3. Density and diversity of the avifauna of desert communities.

Community-desert	State	Pairs per 100 acres	No. of species	Diversity	Equally common species	Key[a]	Reference
Desert Scrub							
Mohave	Calif.	20.0	6	1.486	4.4	1	Robert 1967
	Calif.	39.0	10	2.134	8.4	2	Sheppard 1968
Chihuahuan	N. Mex. (1964)	8.5	6	1.382	4.0	3	Raitt and Maze 1968
	N. Mex. (1965)	17.7	9	1.311	3.7	4	Raitt and Maze 1968
	Texas (1957) (Govt. Spr.)	15.0	2	0.637	1.9	5	Dixon 1959
	Texas (1958) (Govt. Spr.)	9.1	2	0.634	1.9	6	Dixon 1959
Sonoran	Ariz. (area 3)	37.0	10	2.052	7.8	10	Hensley 1954
	Ariz. (area 4)	0.0	0	—	—	—	Hensley 1954
Mean		18.3	5.6	1.377	4.6		
Desert Riparian							
Mohave	Nev. (1968) (Dunes)	6.0	8	1.860	6.4	16	present study
	Nev. (1969) (Dunes)	11.1	13	2.346	10.4	17	present study
	Nev. (1968) (Bosque)	44.3	16	2.671	14.4	18	present study
	Nev. (1969) (Bosque)	48.9	12	2.335	10.3	19	present study
Chihuahuan	Texas (1956) (Black Gap)	51.6	10	2.253	9.5	7	Dixon 1959
	Texas (1957) (Black Gap)	30.0	10	2.276	9.7	8	Dixon 1959
	Texas (1958) (Black Gap)	40.7	10	2.153	8.6	9	Dixon 1959
Sonoran	Calif.	94.5	11	1.932	6.9	13	Hutchinson and Hutchinson 1941
	Calif.	127.0	14	2.279	9.8	14	Hutchinson and Hutchinson 1942
	Ariz. (area 1)	88.0	12	2.325	10.2	11	Hensley 1954
	Ariz. (area 2)	108.0	16	2.380	10.8	12	Hensley 1954
	Ariz.	182.0	22	2.924	18.6	15	Tainter 1965
Mean		69.3	12.8	2.310	10.5		

[a] See figure 2.

productivity, and thus avian diversity and density.

For an analysis of this sort, density should not be converted to pairs per 100 acres because of species-area relationships (see Goodall 1952) unless the study areas are of comparable size. Also, as pointed out by Raitt and Maze (1968), a relationship between density and number of species need not exist, depending on the composition and spacing of the vegetation. For example, the southern Nevada data (except the 1969 bosque data) deviate widely from this regression. Thus certain environmental parameters may be present which allow diversity or density to increase independently.

MacArthur and MacArthur (1961), MacArthur (1964), and MacArthur et al. (1966) have shown the relation of diversity (H') to equally important dimensions of the environment, the most important of which appear to be foliage strata. Using this approach, relationship has been demonstrated between BSD and $\log_e$ of the number of pairs of all species recorded in communities of similar structure (MacArthur 1964; Karr 1968). Raitt and Maze (1968) found no correlation between diversity (H') and density. This suggests that desert communities differ in their structure. To test this, diversity indices (H') were calculated for each of the areas studied (table 3) and plotted versus $\log_e$ of the number of pairs (not converted to pairs/100 acres, fig. 2). The scatter itself shows no correlation. However, when MacArthur's (1964) data for one, two, and three dimension communities are plotted (fig. 2), a more meaningful analysis can be made.

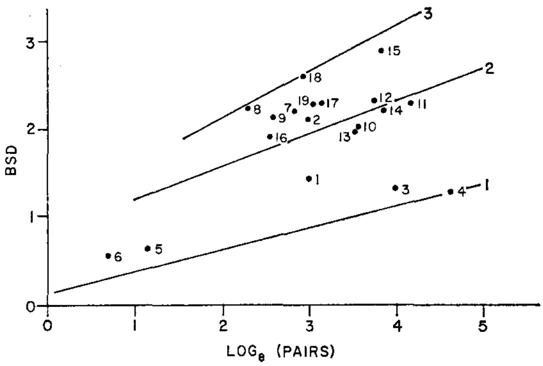

FIGURE 2. Bird species diversity as a function of $\log_e$ of the number of pairs in desert communities (key in table 4; lines for 1-, 2-, and 3-layered communities after MacArthur 1964).

Raitt and Maze (1968) suggested that desert communities are of two types: a desert scrub community-type consisting of low, widely spaced shrubs, and a more mesic desert riparian community-type consisting of larger, more arborescent vegetation.

BSD's of those areas considered desert scrub fall between one and two layered communities (fig. 2), except for the area studied by Sheppard (1968). The presence of a watering tank on the latter may have added a partial dimension. This influence of water has previously been suggested by MacArthur (1964) and Karr (1968) as adding a partial dimension to a community. The areas considered desert riparian have BSD's falling generally between those of communities with two and three equally important foliage strata. The area studied by Hutchinson and Hutchinson (1941, 1942) falls slightly below the two dimension level. Water is present on this area, yet diversity is low. Their description of the area suggests that it may have been more desert scrub-like than riparian. Also, the weakly territorial Costa's Hummingbird was remarkably abundant (35 and 38 pairs/100 acres).

The question arises as to whether desert communities are comparable to those communities examined previously, and if the same layers (0–2, 2–25, and > 25 ft) are "recognized" by desert birds. If so, the partial dimensions above or below that expected from MacArthur's (1964) model must be accounted for.

Unfortunately, FHD data are not available for desert communities previously studied. However, the data for the southern Nevada study area may give some insight into this problem (fig. 1). Using the horizontal layers (0–2, 2–25, and > 25 ft, MacArthur and MacArthur 1961) to calculate FHD, the dunes have 1.93, and the bosque, 1.11 equally important layers (FHD = 0.656 and 0.107, respectively). The composite study area has approximately 1.78 equally important layers (FHD = 0.579). As seen previously (fig. 2), this does not explain BSD for the study area. In examining the foliage profiles (fig. 1), there appear to be breaks at the 3- and 6-ft levels. If birds "recognize" these layers, this should explain BSD. FHD, calculated on the basis of three vegetation layers (0–3, 3–6, and > 6 ft), gives values of 2.14, 2.40, and 2.96 equally important layers (FHD = 0.759, 0.877, and 1.084) for the dunes, bosque, and composite study area, respectively. On this basis, the data fall close to the regression of BSD versus FHD for many habitats (see MacArthur 1964; MacArthur et al. 1966). This close fit (fig. 3) justifies the above division of the foliage profile. Further justification is obtained by examining the vegetation itself. Natural breaks occur at both the 3- and 6-ft levels in both habitats.

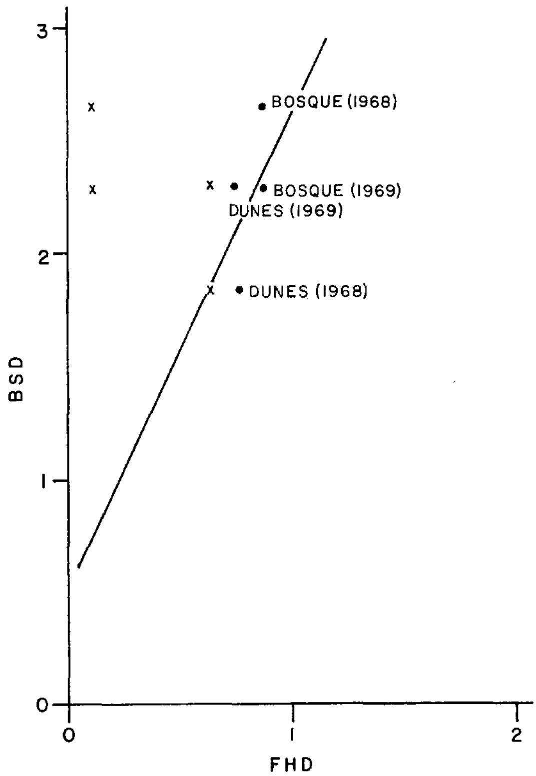

FIGURE 3. Bird species diversity as a function of foliage height diversity on desert riparian habitat in southern Nevada (dots and x's represent FHD calculated 0–3, 3–6, > 6 ft layers and 0–2, 2–25, > 25 ft layers, respectively; regression line after MacArthur 1964).

Desert habitats that are more arborescent (desert riparian) appear in figure 2 as having between two and three equally important layers, similar to those found in the present study. It seems that FHD, as determined for the present study, may be generally related to BSD in most riparian communities in desert regions. Similar arguments may also hold for desert scrub. Desert birds apparently "recognize" a slightly different layering of the vegetation than birds of other temperate communities. This may account for the pattern as seen in figure 2, namely a relationship about half a dimension below those shown by MacArthur (1964).

One of the limitations of predicting BSD from FHD, as discussed by MacArthur (1964), is that some foliage types may be of limited use to birds and BSD may be lower than expected. This situation may exist in certain desert communities.

Creosotebush is the dominant shrub of most scrub communities of the warm North American deserts (McCleary 1968). This species was present (generally dominant or codominant) on all areas here considered except those of Sheppard (1968) and Robert (1967). Few avian species utilize this shrub. Anderson and Anderson (1946) reported a few species utilizing creosotebush for foraging but none for a nest site. Raitt and Maze (1968) found only the Black-throated Sparrow nesting in this shrub, and Tainter (1965) observed no species utilizing creosotebush. Davis (1963) and Hensley (1954) found no breeding birds in pure creosotebush stands. I found no nests in creosotebush, although this shrub contributed 6.3 per cent to the total foliage volume of the study area (13.4 per cent in the dunes). Other shrubs were used relative to their contribution to total foliage volume (table 1).

These data indicate the small contribution of creosotebush to the foliage profile that is important to birds. Further studies on BSD in relation to FHD and studies similar to that of Balda (1969) are needed in desert communities.

On the southern Nevada study area, the greater relative density of birds in the bosque (table 2) was apparently due to a greater foliage volume compared to that of the dunes. Also, the greater shade afforded by the taller screwbean mesquite provides a more moderate environment. Midday shade temperatures in the bosque average 5–6° cooler than on the dunes, and a relative humidity 6–8 per cent higher (pers. observ.).

Populations in the bosque remained fairly constant through both years. On the dunes, the increased breeding population and BSD in 1969 appeared to be a reflection of a large crop of mistletoe berries produced in 1968 which carried over into the spring of 1969. Several species (Cactus Wren, Mockingbird, Crissal Thrasher, Phainopepla) which feed on mistletoe berries showed an increase on the dunes in 1969. A bumper food crop may, therefore, add a partial dimension to a habitat.

SUMMARY

Bird populations were studied in desert habitat dominated by mesquites in southern Nevada. A total of 20 species was found at densities of 31.5 and 44.0 pairs per 250 acres in 1968 and 1969, respectively. Nest site selection generally depended on availability of the various plant species.

An analysis of bird species diversity in desert communities demonstrates that desert scrub communities are equivalent to approximately 1.5-layered communities and desert riparian communities are equivalent to approximately 2.5-layered communities. Preliminary data indicates that desert birds "recognize" a more compressed foliage layering than birds in other temperate communities. Creosotebush appears to add little to the foliage profile of importance to birds.

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