

Urban development effects on the abundance of some common resident birds of the Tucson area of Arizona

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THE IMPORTANCE OF ORNITHOLOGICAL studies in urban and suburban environments has been discussed by Emlen (1974), who compared the bird population of a creosotebush-bursage community (Lowe 1964), with that of an urban single-family homes area in Tucson, Arizona. We were interested in the changes caused by residential development in a rich avian habitat, the paloverde-saguaro community (Lowe 1964). This community flourishes on the bajadas, the gently sloping alluvial fans composed of loosely compacted materials eroded from the mountains surrounding Tucson. Because of their scenic position overlooking the city, the bajadas are highly desirable as residential areas and are rapidly being altered by bulldozers and construction. We surveyed three areas: an 8.1-hectare paloverde-saguaro exurban tract with a house in 0.4-hectare of exotic vegetation (mostly citrus) in the northeast corner; a 10.1-hectare suburban area, containing 17 evenly distributed houses, with minimal exotic vegetation and with remaining land in paloverde-saguaro; and an 11.1-hectare urban mobile home park with varied exotic vegetation and containing about 225 homes. The areas are described in detail by Tainter (1965) and by Tweit and Tweit (1984a, 1984c).

METHODS

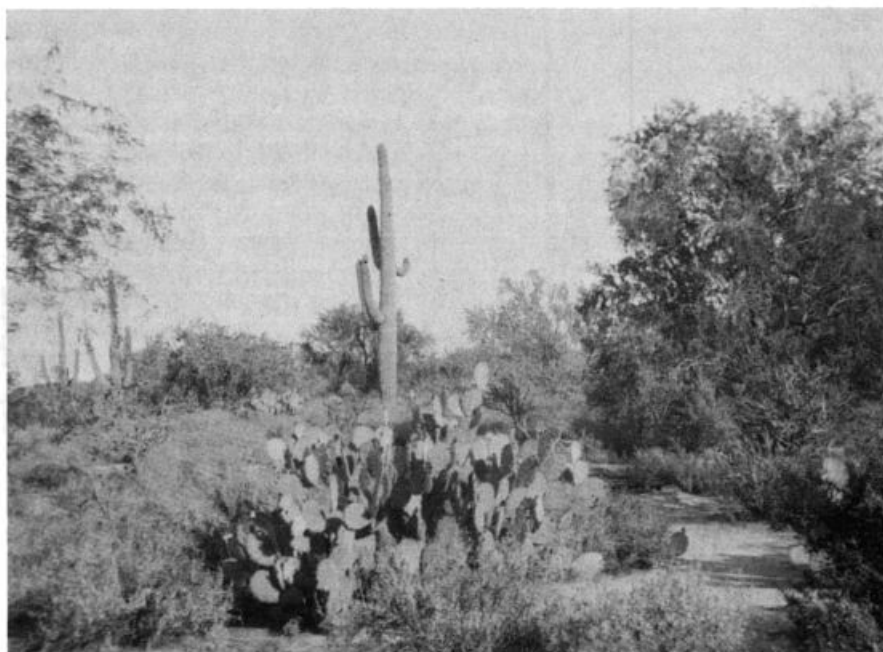
We chose the Winter Bird-Population Study (hereafter, WBPS) format for

our work because this and the related Breeding Bird Census (hereafter, BBC) had been used in similar studies. Areas of about 10-hectare with good accessibility and visibility provided an opportunity for a reasonably complete count. Most breeding birds of the paloverde-saguaro community are permanent residents. More than 80% of the species in Emlen's breeding season study (1974, Fig. 3) were year-round residents. Our studies in paloverde-saguaro were conducted from early January to early March at a time of active pre-breeding

vocalization. Variability at that time between individual censuses is higher than in the breeding season as some species use a larger feeding territory in winter (Tweit and Tweit 1983).

RESULTS

A comparison of the three areas with those in the literature is provided by Table 1. The areas are: undisturbed paloverde-saguaro in the 1960s (Anderson and Anderson 1972); Emlen's urban



Saguaros and Paloverdes in the exurban Bajada habitat. Photo/Tweits.

study (1974), suburban Tucson (Tainter 1965); moderately-disturbed paloverde-saguaro surrounding the Tucson Mountain information station in Saguaro National Monument (Tweit and Tweit 1981a, 1982a); two urban mobile home parks with many mulberry trees and other exotic vegetation (Tweit and Tweit 1981b, 1982b); and undisturbed paloverde-saguaro, part of a larger tract surrounded by suburban development (Webb 1982). We converted all results expressed as birds/100 acres to birds/km² and have multiplied the BBC results (pairs) by 2 to obtain comparable totals of adult birds. The less than (<) numbers are derived from the + symbols in the WBPS and BBC format, which indicate numbers less than 0.5. Plus marks indicate irregular visitors to a breeding census area.

It is apparent from the data in Table 1 that little change in the bajada avifauna occurs with moderate development (2 houses/ha) as long as native vegetation remains. When the native vegetation is replaced by exotic plants,

as in the urban mobile home parks and Emlen's urban area, the avifauna changes dramatically, with the disappearance of some species and the appearance of others. Inca Doves (*Columbina inca*), and House Sparrows (*Passer domesticus*), make up more than 70% of the numbers of individuals in the urban habitats, and when these birds are subtracted from the area totals, the numbers drop below the totals for the bajada areas, except in Emlen's area (1974) with its large population of House Finches (*Carpodacus mexicanus*).

Similarities in breeding and winter densities (Table 1) for the Gila Woodpecker (*Melanerpes uropygialis*), Verdin (*Auriparus flaviceps*), and Curve-billed Thrasher (*Toxostoma curvirostre*), in paloverde-saguaro habitat suggest that these species may maintain the same territory size all year.

Some species apparently cannot adapt to exotic vegetation or the increased density of buildings. Black-tailed Gnatcatchers (*Poliotila melan-*

ura), Pyrrhuloxias (*Cardinalis sinuatus*), Brown Towhees (*Pipilo fuscus*), and Black-throated Sparrows (*Amphispiza bilineata*), are the most sensitive to vegetation changes. We have never seen them in urban areas and Emlen (1974) did not find them in his urban area. Phainopeplas (*Phainopepla nitens*), are rarely seen in urban areas. In contrast, European Starlings (*Sturnus vulgaris*), and House Sparrows, the most wide-ranging of the urban species, venture out into native vegetation and even nest in woodpecker holes in Saguaros (*Cereus giganteus*). The increase in abundance of these species in the suburban area in the 18 years between Tainter's census and ours is possibly results from the growth of exotic vegetation around the houses and the addition of six more houses.

SPECIES' HABITAT PREFERENCES AND DENSITIES

GAMBEL'S QUAIL (*Callipepla gambelii*) is the most common bird of semi-

Table 1. Density (individuals/km²) of resident birds of the Tucson, Arizona, area in various habitats.

Species	Bajada (B) Andersons	Bajada (W) Tweits '81	Bajada (W) Tweits '82	Bajada (B) Webb	Exurban Bajada (W) Tweits	Suburban Bajada (W) Tweit	Suburban Bajada (B) Tainter	Urban MHP (W) Tweits '84	Urban MHP (W) Tweits '82	Urban MHP (W) Tweits '81	Urban (B) Emlen
Gambel's Quail	40	267	213	50	138	139	100	—	—	—	+
Mourning Dove	60	56	11	108	83	30	20	<5	6	6	74
Inca Dove	—	—	—	—	—	20	—	173	253	364	568
Greater Roadrunner	10	—	<6	10	—	<5	60	—	—	—	—
Gila Woodpecker	40	22	34	50	58	30	60	<5	6	6	35
Ladder-backed Woodpecker	—	<6	<6	20	<6	<5	—	—	—	<3	—
Northern Flicker	30	<6	11	40	20	20	20	<5	—	<3	+
Verdin	30	22	56	60	58	59	60	9	—	6	35
Cactus Wren	134	33	11	60	37	50	80	<5	12	6	5
Black-tailed Gnatcatcher	10	11	11	20	6	10	—	—	—	—	—
Northern Mockingbird	20	—	—	+	—	20	20	64	31	31	111
Curve-billed Thrasher	67	44	34	98	58	59	80	<5	<3	6	12
Phainopepla	40	<6	<6	20	<6	10	+	—	—	—	+
European Starling	—	—	—	20	<6	40	+	9	12	6	86
Northern Cardinal	—	<6	11	10	12	10	40	5	6	6	42
Pyrrhuloxia	—	—	—	40	<6	10	—	—	—	—	—
Brown Towhee	20	33	34	+	12	10	60	—	—	—	—
Black-throated Sparrow	20	89	11	20	37	10	40	—	—	—	—
House Finch	30	22	22	40	12	99	60	136	111	111	420
House Sparrow	—	<6	—	10	—	79	20	500	463	401	1284
Total	551	614	468	676	540	710	680	906	902	955	2672

(B) denotes Breeding Bird Census. (W) denotes Winter Bird-Population Study.

natural areas, perhaps owing to the presence of seed feeders. Since some feeding occurred in all areas except Webb's and the Andersons', their figures of 40–50 are presumed to represent the natural abundance in palo verde-saguaro. Detectability is a problem; although quail are vocal, numbers are difficult to determine from calls alone and aural detection usually gives a low count. The bajada averages are in striking contrast to Emlen's (1974) count of 0.8/km² in creosotebush-bursage habitat. Phillips, Marshall, and Monson (1964) link this species with the presence of mesquite (*Prosopis sp.*), but our 1981–1982 bajada tract has no mesquite and the suburban tract very little. Based on our observations, thick wash-edge vegetation, generally absent in creosotebush-bursage, is a favored night roost; Zembal (1982) found a density of 286 in a California palo verde-chuparosa habitat. Emlen (1974) found individual visitors in his urban study area and we saw coveys in an urban mobile home park adjacent to a concrete-lined wash. The presence of cats may be a factor influencing the abundance of quail in urban and suburban areas. The Andersons (1972) reported cats as the most important predator on the Cactus Wren (*Campylorhynchus brunneicapillus*), another ground feeder.



Exotic vegetation in an urban Mobile Home Park. Photo/Tweits.

INCA DOVE. Phillips *et al.* (1964) reported that the Inca Dove was absent from Arizona before 1870, when it began moving north from Mexico. The success of this species in the suburban area is probably owing to a combination of increased numbers of seed feeders, availability of water, and growth of exotic shade trees. Doves in suburban habitats do not appear to be simply

wanderers from a more high urbanized area; their individual winter feeding areas are about the same size as the study areas (Tweit and Tweit 1983). Perches and potential nest sites are apparently important factors since our 1981–1982 urban study area had more and larger White Mulberry trees (*Morus alba*) and Emlen's (1974) single-family home area with many utility wires had



Inca Dove. Photo/Allan D. Cruickshank/VIREO.



Yellow-shafted Flicker. Photo/Allan D. Cruickshank/VIREO.

the highest density. Because of this abundance in urban areas, second only to that of the House Sparrow, easy detectability, and fidelity to the works of man, this is *the* indicator bird of civilization in the Tucson area. Emlen's density figure (568) from an area with ample food may approach the maximum. The Inca Dove's habitat requirements are easier to understand than those of the ubiquitous Mourning Dove (*Zenaida macroura*).

GREATER ROADRUNNER (*Geococcyx californianus*), is a difficult species to census accurately because individuals are vocal for only a short period of the year and they rarely fly. Tainter's (1965) figure of 60/km² may approach maximum abundance for a favorable habitat with ample food. The Andersons' and Webb's figure of 10 may represent the natural density in paloverde-saguaro habitat.

GILA WOODPECKER. The abundance of this adaptable bird outside of riparian areas is apparently determined by the number of Saguaros available as nesting and roosting sites; residential development to a level of nearly two houses/hectare did not change its density sig-

nificantly. The nest sites being used in Emlen's (1974) urban area deserve more study, since this habitat is obviously more attractive than our mobile home parks. He found only 0.8/km² in his creosotebush-bursage area and two other studies in similar habitat (Moore and Wahlstrom 1972; Viers and Sileo 1972) found none at all, again showing the dependence of these birds on suitable nest sites. A density range of 50–60 probably represents the maximum in paloverde-saguaro.

LADDER-BACKED WOODPECKER (*Picoides scalaris*). The small size of this species, which enables it to nest in yucca stalks (Phillips *et al.* 1964), may prevent it from using the larger and harder substrates available in urban areas. Harrison (1979) reported that cavities were usually excavated in rotten, dead, or dying tree branches. More research is needed to define its habitat preferences within paloverde-saguaro.

NORTHERN FLICKER (*Colaptes auratus*). This is another woodpecker that uses the Saguaros as a nest site, but with less specific habitat requirements than the Gila. Emlen (1974), Moore and Wahlstrom (1972), and Viers and Sileo (1972) found it in creosotebush-bursage

in densities of 4–8/km². Although its abundance is not reduced in suburban bajada areas, further urbanization apparently eliminates it as a breeder. The similar winter and summer densities are of interest since the permanent resident "Gilded" race is augmented in winter by "Red-shafted" individuals moving down from higher elevations.

VERDIN (*Auriparus flaviceps*). The most interesting observation here is the uniformity of density determinations in bajada habitat by three observers in two seasons. The peak abundance of 56–60 seen in five bajada areas rich in paloverdes agrees with the density (61) found by Weathers and Mayhew (1981) in California desert woodland. Bajada is the preferred habitat; the highest abundance reported for creosotebush-bursage is 35 (Moore and Wahlstrom 1972), and Emlen (1974) found only 6.3.

In his urban area Emlen found a much higher density than we found in our mobile home parks which have few *Parkinsonia*, supporting his theory that Verdins may use these trees as nest sites in urban areas. The one nest we found in our urban mobile home park was in a cholla (Tweit and Tweit 1984c).



Verdin. Photo/Allan D. Cruickshank/VIREO.

CACTUS WREN. Since this is a species with a nesting preference for cactus (Anderson and Anderson 1972), it is not surprising to find the maximum densities in areas well-supplied with these plants. Moderate development (2 houses/ha) in this vegetation type seems to have little effect on abundance. The variation between winter and summer population densities may be a function of seasonal differences in conspicuousness. It is interesting that the highest density was obtained using color banding (Anderson and Anderson 1972). This is consistent with the findings of Bart and Schoultz (1984) that aural surveys underestimate the most common birds.

BLACK-TAILED GNATCATCHER. This bird, which nests near the ground (Harrison 1979), obviously finds urban areas unsuitable and is another good indicator of undisturbed native vegetation. Density data suggest that this species does not show a preference for either saguaro-paloverde or creosotebush-bursage vegetation types, and the 18 (Moore and Wahlstrom 1969) to 20 abundance range may represent its maximum, with an average of 11 for paloverde.

NORTHERN MOCKINGBIRD (*Mimus polyglottos*). "There are peculiar seasonal variations in the numbers of mockingbirds in southern Arizona not yet fully understood" (Phillips *et al.* 1964). How many, if any, of the same birds are present all year is unclear, but these studies suggest that mockingbirds in the Tucson area are attracted to suburban and urban vegetation communities.

CURVE-BILLED THRASHER. This species adapts to almost any habitat containing large cholla cacti, the preferred nest site. The density increases from 12 in creosotebush to about 63 in paloverde and drops to 3 in mobile home parks and 13 in Emlen's area (1974). This pattern is similar to that of the Cactus Wren. Territories of two to four hectares may be the minimum size for paloverde-saguaro habitat.

EUROPEAN STARLING. This adaptable invader apparently needs a base of human habitation from which to colonize the nearby desert, since the more remote study areas were still untouched (Webb's area is surrounded by suburban development). The drop in abundance in mobile home parks is related to a decrease in nest cavities, obviously remedied in Emlen's (1974) urban area, al-



Northern Mockingbird. Photo/Allan D. Cruickshank/VIREO.

though he did not mention specific nest sites. Harrison (1979) reported that starlings used any available hole or crevice.

NORTHERN CARDINAL (*Cardinalis cardinalis*). In contrast to the Pyrrhuloxia, another species most often found near washes, the cardinal does adapt to human development and reaches densities as high as any in desert scrub in Emlen's area where ample food and nest sites are available.

BROWN TOWHEE. This ground-feeding bird is another that disappears in urban Tucson. Density in the paloverde-saguaro association is usually greater than in creosotebush-bursage, where Moore and Wahlstrom (1969), Viers and Sileo (1969), and Emlen (1974) found averages ranging from <4 to 17. The absence of breeding in Webb's area is difficult to explain.

BLACK-THROATED SPARROW is an adaptable bird in desert scrub for which



Curve-billed Thrasher. Photo/Allan D. Cruickshank/VIREO.

creosotebush is as satisfactory a habitat as paloverde. The variation in winter densities between years suggests flocking and large winter feeding areas. As with towhees, the abundance variations between studies show that more data are necessary to draw statistically significant conclusions about habitat preferences.

HOUSE FINCH is the most adaptable of the Tucson area native birds, feeding on seeds, tree buds, seed at feeders and sugar water at hummingbird feeders. Since it nests in a variety of situations (Harrison, 1979), its widespread occurrence and high density is not surprising. The range of 20–40/km² represents the usual breeding density in paloverde habitat within 3–5 km of available water (Emlen 1974). In winter it uses larger feeding territories (Tweit and Tweit 1983).

HOUSE SPARROW. This aggressive species is rarely found far from buildings, but will nest in Saguaro cavities in partly developed areas. The House Sparrow prefers exotic vegetation such as palm trees and Italian cypresses as nest sites. Seed feeders are used extensively as a food source.

SUMMARY

Abundances for resident birds from Winter Bird-Population Studies and Breeding Bird Censuses indicate that paloverde-saguaro is a diverse desert avian habitat in the Tucson area. Residential development in this habitat at a level of 2 houses/ha does not reduce density or diversity when native vegetation is maintained. Removal of native vegetation and denser development dramatically change the avian community, eliminating or greatly reducing the numbers of most native species and increasing the numbers of Inca Doves, Northern Mockingbirds, House Finches, and House Sparrows.

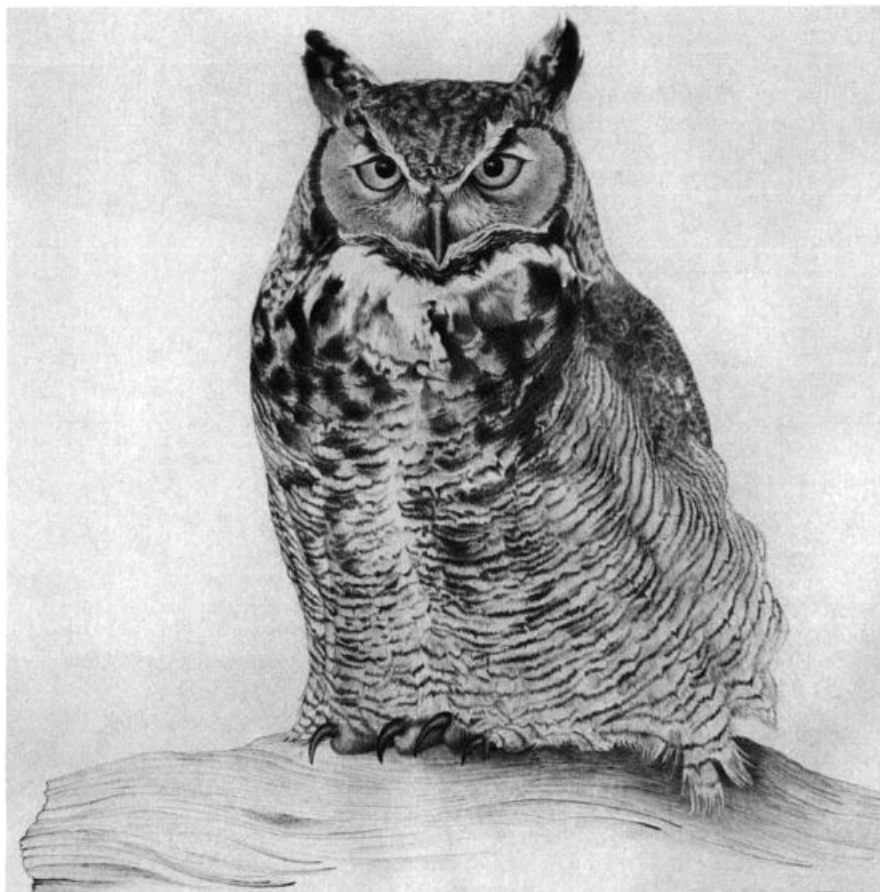
The WBPS and BBC are useful tools for analyzing densities of resident avian species, comparing habitat areas and determining which species maintain the same size territory all year.

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Great Horned Owl (*Bubo virginianus*). Illustration/Bruce A. Morrison.