

had already laid three eggs. We found a 17-inch Black Rat Snake (*Elaphe obsoleta*) in a nest that had, when last examined by us, held three bluebird eggs. From ten nests all bluebird eggs were removed, and from five others all hatchlings, presumably by some predator. In all 15 cases the nests proper were left intact, however, a circumstance suggesting snake predation. Two nest boxes were found askew, their nesting material in disarray, eggs missing. I suspected that Raccoons (*Procyon lotor*) were responsible.

Two nests were deserted after prolonged incubation (18 and 21 days, respectively) in late July. In four other July nests we found dead nestlings. These losses I attributed to high temperatures.

One nest containing three eggs was deserted for no apparent reason. Possibly one or both of the adults met with disaster. One nest that held three bluebird eggs was deserted after two cowbird eggs were added.

Around one nest that was completed by 31 March 1972, I never saw adult birds and no eggs were laid. When we removed this nest in order to clean the nest box on 18 May, we found a paper-wasp's nest under the lid and—under the bluebird nest—the mummified carcass of the male bird. The female apparently had completed her nest after the death of her mate. Three other completed nests never received eggs.

Though Friedmann (1929, *The Cowbirds*, Charles C. Thomas, Springfield & Baltimore, p. 260) called *Sialia sialis* "a very uncommon victim" of the cowbird, our Pontotoc County population was several times parasitized. My nest boxes had a perch just below the entrance. I was to learn that boxes designed without such a perch receive little parasitism by cowbirds.

Cowbird eggs appeared in bluebird nests from 21 April until 28 June. Five nests were parasitized in April, three in May, and four in June. Cowbird parasitism had little effect on the nesting success of bluebirds during this study.

Other cavity-nesting birds that successfully used our nest boxes included the Carolina Wren (*Thryothorus ludovicianus*), Carolina Chickadee (*Parus carolinensis*), and Tufted Titmouse (*P. bicolor*). House Sparrows attempted to nest in the boxes, but I destroyed their nests each time I found them. Starlings (*Sturnus vulgaris*) investigated boxes, but the openings were apparently too small for them and I found no evidence of their nesting.

A Flying Squirrel (*Glaucomys volans*) occupied one box for several weeks. Fox Squirrels (*Sciurus niger*) damaged or destroyed a few boxes by enlarging the entrance hole.

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## WINTER FORAGING HABITS OF THE ROADRUNNER

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Little is known of the winter foraging behavior of the Roadrunner (*Geococcyx californianus*) in non-desert habitats (but see Geluso, 1970, *Bull. Oklahoma Orn. Soc.*, 3: 32). I observed nine adult (or adult and first-year)

Roadrunners at Buncombe Creek Recreation Area near Willis, Marshall County, south-central Oklahoma and at Hagerman National Wildlife Refuge near Sherman, northeastern Texas, during December in 1976 and 1977, thus obtaining information on foraging habits and on relative success in different habitats.

The Roadrunners that I observed restricted their foraging to areas of short and tall grasses. Never did I see them foraging in bushy or wooded areas. Both study areas were characterized by clearings of mowed grass generally less than 10 centimeters (3½ inches) high and border areas of taller grass more than 10 centimeters high. The Roadrunners ate ground and flying insects. I did not observe them catching birds or mammals. On only one occasion did I happen upon a reptile — this a snake about .5 meters (1½ feet) long and perhaps too large to be preyed upon by a Roadrunner. I believe that lizard and snake activity was greatly reduced at this time of year and that the Roadrunners were forced to eat smaller prey than they usually eat in spring and summer. I believe that true grasshoppers (Family Acrididae) were a large component of their diet. Grasshoppers seemed to be plentiful and the Roadrunners captured flying ones from time to time with a leap into the air.

During the 280 field hours of this study, daytime air temperatures varied from -10° to 27° C. (14° to 80° F.) and there was no snowfall. Using a 7 x 50 binocular and a 20x spotting scope, I observed the birds between 0800 and 1600 from a vehicle. While watching a Roadrunner, I recorded a note on its behavior every 30 seconds. The 3478 notes that I recorded included comments on standing, walking, and running. If I observed swallowing when the bird remained in an area of constant grass height, I measured the grass height at five two-pace intervals after concluding observations.

Though the Roadrunners did leap into the air to catch flying grasshoppers now and then, they never did so on the 30-second mark at which I noted their behavior. Leaping behavior does not, therefore, appear in this analysis.

I calculated (1) average grass height, (2) swallows per minute, and (3) percentage of time spent standing, walking, and running during 48 periods (each of 3 to 59 minutes) of foraging observation.

Roadrunners walked or ran through the grass, taking insects from the grass or from the air and swallowing them conspicuously. As grass height increased, the Roadrunners stood still less frequently. They swallowed more items per minute in short grass than they did in tall grass.

As grass height increases, a Roadrunner's field of view is reduced and the bird may spend more time moving since it uses less time in surveying the field. In tall grass a Roadrunner appears to be encumbered or discomfited by the grass — a condition that may accompany, or even be brought on by, reduction of foraging efficiency.

Results of my study differ from those of Brownsmith (1977, Condor, 79: 386-388), who, after studying Starlings (*Sturnus vulgaris*), reported that they spent more time standing in grass taller than 6 centimeters (2½ inches) than

in grass less than 6 centimeters tall. This difference in behavior between Starlings and Roadrunners may be explained by the difference in the food of the two species. Brownsmith's Starlings ate seeds as well as insects (personal communication), whereas my Roadrunners ate insects only. In tall grass a Starling is a "gleaner," and may pause from time to time, looking for insects. Roadrunners, on the other hand, are "flushers," detecting and disturbing insect prey as they forage. Roadrunners should spend less time standing still in tall grass than Starlings do if movement of insects is a more important cue for them than it is for the Starlings. The fact that Starlings and Roadrunners use different foraging strategies results in contrasting behavior within the same sort of habitat.

That Roadrunners forage in less than optimal areas (grass height greater than 10 centimeters) is puzzling. Roadrunners should, it would seem, spend all of their foraging time in areas of greatest efficiency (grass height less than 10 centimeters), but repeatedly I saw them foraging in tall grass. Though this may be inefficient for them from a feeding perspective, it may have certain advantages. Tall grass may provide shelter from wind and protection from some predators. Too, the tall grass areas may be the only areas that territorial pairs allow young birds to use.

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### GENERAL NOTES

**Winter records of White-necked Raven in eastern Beckham County, Oklahoma.**— The White-necked Raven (*Corvus cryptoleucus*) probably breeds regularly near Elk City in Beckham County, southwestern Oklahoma, but I have never found its nest in the area. On 13 May and 26 July, 1974, I distinctly heard its calls along a creek in the city itself. The woodlands of the region are inhabited by Common Crows (*C. brachyrhynchos*), whose *caws* are instantly distinguishable from the guttural *cronks* of the ravens. In general appearance the two species are much alike, for the white of the raven's neck does not often show in the field.

I have come to consider the White-necked Raven a regular fall and winter visitant to a pecan orchard that is just across a small stream from my house in Elk City, and in plain view to me. Here, when the crop of nuts is good, I often hear the birds, especially early in the morning. The pecan crop was unusually good in 1978. That fall and winter I heard the ravens every day from 3 to 10 November, on 5 December, and repeatedly between 24 January and 25 March. I name the dates not from memory but from a diary that I keep.

The pecan crop in 1979 was not good. I did, however, hear the ravens in the orchard between 16 and 28 October, again on 26 December, on 15 January, and from 2 to 19 February. Occasionally one perched on the power-line pole by my house.

The pecan crop was a total failure in 1980. Too, Soil Conservation Service work on the creek created so much disturbance that during the following fall