Darley (Auk 88:560–566, 1971) (the only other published estimate of Brown-headed Cowbird survivorship) based his study on a local breeding population in Ontario. Darley estimated survivorship as the percentage of birds banded one year that returned to breed in the same area the following year. He estimated 62% survivorship for adult males and only 45% for adult females, based on 60 and 40 initially banded birds, respectively. Male survivorship is greater than, and female survivorship less than our estimates for southeast Texas.

Our estimates of annual survivorship rates for cowbirds that winter in southeast Texas tend to be greater than Fankhauser's (1971) estimates for the North American population as a whole. This difference is slight (and not significant) for males, but it is great (and highly significant) for females. Thus, we might conclude that migrating farther south confers some survival advantage, especially for females. We find it especially interesting that these females appear to experience considerably better survivorship than the males with whom they roost in the winter (63 vs 53%), when both Fankhauser (1971) and Darley (1971) reported lower female survivorship. Our results are consistent with the observation (Johnson et al., 1980) that mortality experienced in the Houston roost was due to food-limitation, and tended to affect males more than females in some years. Perhaps some as-yet-unidentified difference in foraging behavior, related to sexual dimorphism in size, causes the minority sex (females in southeast Texas roosts) to experience less competition for food and enjoy better survival.

We thank William E. Grant and R. Douglas Slack for comments on the manuscript. This is contribution TA 16971 from the Texas Agricultural Experiment Station.—KEITH A. ARNOLD, *Dept. Wildlife and Fisheries Sciences, Texas A&M Univ., College Station, Texas 77843,* AND DAN M. JOHNSON, *Dept. Biological Sciences, East Tennessee State Univ., Johnson City, Tennessee 37614.* *Accepted 20 Apr. 1982.*

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Flocking pattern of foraging American Crows in Oklahoma.—Field studies of American Crows (*Corvus brachyrhynchos*) outside the breeding season have concentrated upon the large communal roosting sites that these birds use during the winter (e.g., Kalmbach and Aldous, Wilson Bull. 52:198–206, 1940; Haase, Ohio J. Sci. 63:145–151, 1963). The implication from those studies is that the roosting flock is the social unit for the species at this time of year, and that birds disperse broadly to forage. Two hypotheses have been proposed as to how crows may find food when leaving the roost. The first maintains that birds are attracted to birds already foraging. Hinde (pp. 373–411 *in* Biology and Comparative Physiology of Birds, A. J. Marshall, ed., Academic Press, London, England, 1971) referred to this process as foraging by "local enhancement." The alternative hypothesis is that the roost serves as a "center" (Ward and Zahavi, Ibis 115:517–534, 1973) where birds obtain information about the location of food resources nightly, and then fly to sites having greatest availability of food resources the following morning. A recent study (Loman and Tamm, Am. Nat. 115:285–289, 1980) inconclusively addressed these theories relative to food finding by Hooded Crows (*C. cornix*) and Common Ravens (*C. corax*). From November 1977 through September 1978 we monitored the size of flocks of foraging crows in north-central Oklahoma and observed habits of those flocks. The observations lead us to speculate that the social unit of American Crows is the family throughout the year, and raise some doubts about the dependence of crows upon either of the two approaches to locating food resources during winter as proposed by Hinde (1971) and Ward and Zahavi (1973).

We recorded the location and flock size of all crows observed foraging between 08:00 and 16:00 within a 25-km radius of Stillwater, Payne Co., Oklahoma, 1 November 1977–30 September 1978. Most crows foraged in rangelands within 10 km of a roost-site located 13 km

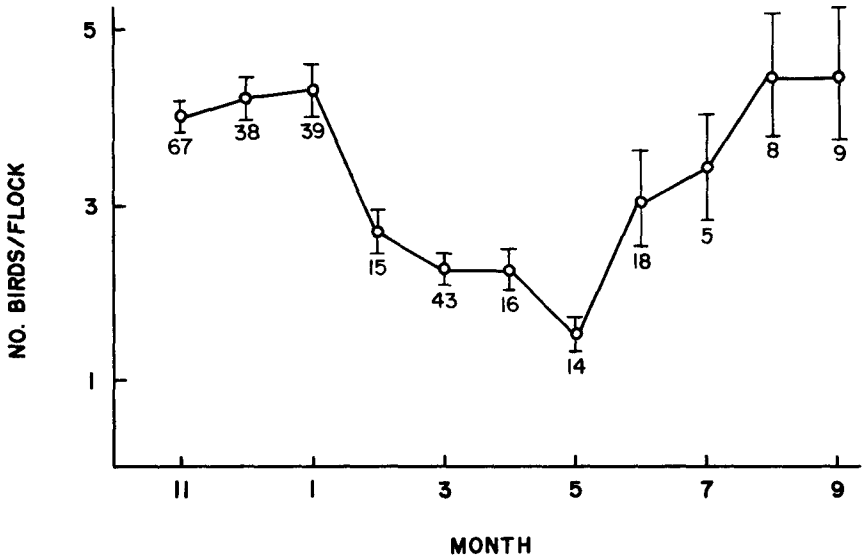

FIG. 1. Mean (±SE) flock size of foraging crows in north-central Oklahoma, November 1977–September 1978. Respective sample sizes are given on the figure.

due east of Stillwater. Occasionally crows foraged in riparian or oak (*Quercus* spp.) woodlands. We do not include those flocks herein as we were unsure that we saw all birds in a flock.

Crows migrated into Oklahoma in large numbers during October 1977. An estimated 300–400 crows used the communal roost-site that winter. This site was located in cottonwood trees (*Populus* spp.) along an intermittent stream. Birds usually dispersed from the roost in varied directions shortly after first light each morning. They generally began foraging on the ground about sunrise.

Relative to the larger communal roost, crows foraged in small flocks. Flocks observed 1 November–31 January ranged from 1–9 individuals with 119 of 144 (82.6%) comprising 3–6 birds. Mean flock size was 4.1 ± 0.13 birds. From late morning through the remainder of the day crows appeared to spend less time foraging. By mid-afternoon they began concentrating in larger, nonforaging groups (secondary roosts), usually in trees, prior to moving back to the communal roost at sundown.

We continued to monitor flock sizes of foraging crows through the nesting season and summer of 1979. Birds began to appear more frequently in flocks of two (pairs?) about mid-February and mean flock size reached a minimum in May (Fig. 1). Nesting activities occur 5 March–31 May in Oklahoma (Sutton, Birds of Oklahoma, Univ. Oklahoma Press, Norman, Oklahoma, 1967). Flock size increased markedly in June, and gradually thereafter through September.

Crows remain in family units after fledging (Good, The Life History of the American Crow *Corvus brachyrhynchos* Brehm, Ph.D. thesis, Ohio State Univ., Columbus, Ohio, 1952) at least until that time when they leave the breeding grounds (D'Agostino et al., Wilson Bull. 93:394–395, 1981). We attribute the dramatic increase in flock size of Oklahoma crows in

June to the presence of fledglings accompanying their parents to the foraging sites. As mean flock size of birds that bred in Oklahoma was comparable in September to what we saw among migrants during the previous winter, we hypothesize that at least some young spend their first winter with their parents.

Our hypothesis is supported by additional observations. Flocks of foraging crows often had the same number of individuals within the same vicinity for 2–20 days consecutively, as if on a winter territory. Two such flocks (of four and five individuals, respectively) were noted repeatedly about 0.5 km apart in a field along a highway over the course of 9 days in mid-January. On the ninth day we watched the flock of four fly into a cottonwood tree within 50 m of where the flock of five was foraging on the ground. The flock of five immediately flew to the tree, and all nine crows fought noisily for about 15 sec. After the interaction the crows left the site in two flocks (four and five individuals) in opposite directions. On subsequent days only a flock of five was present in that vicinity. Finally, we noted that during the winter many (48 of 144, 33.3%) flocks of foraging crows were accompanied by 1–2 sentinel birds. D'Agostino et al. (1981) recently proposed that sentinel behavior by American Crows was an extension of parental care.

From these observations we infer that the basic social unit of nonbreeding crows may be the family and not the roost as implied by theories proposing information exchange about the location of food resources. Family relationships may be obscure where crows winter in large roosts and also forage in large flocks. However, large roosts in Oklahoma occur in areas of abundant, localized foods in the form of cultivated crops (grains, pecans, etc.) produced by intensive agricultural practices (Aldous, J. Wildl. Manage. 8:290–295, 1944). Our observations were of a smaller roost in native grassland/savannah habitats with negligible tillage. Whereas crows may follow other birds (share information) from large roosts to feeding sites or be attracted to birds already foraging (local enhancement) in areas of abundant or concentrated foods, in native landscapes the roost appears to serve some other (thermoregulatory, antipredator, etc.) functions (Broom et al., Bird Study 23:267–279, 1981) which seem inherent to the roost-site itself.

These interpretations benefited from discussions with Fred B. Samson.—FRITZ L. KNOPF AND BARBARA A. KNOPF, *Dept. Ecology, Fisheries and Wildlife, Oklahoma State Univ., Stillwater, Oklahoma 74078.* (Present address: FLK: *Denver Wildlife Research Center, 1300 Blue Spruce Drive, Fort Collins, Colorado 80524-2098;* BAK: *Wildlife Society Bulletin, 201 Wagar Building, Colorado State Univ., Fort Collins, Colorado 80523.*) *Accepted 30 May 1982.*

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An additional method of foraging in litter by species of *Turdus* thrushes.—Although ground-foraging birds often feed directly from the surface, many also excavate the litter in one or more distinct ways to uncover hidden food. For example, unilateral (single) scratchers use one leg at a time to move litter, e.g., many gallinaceous birds and Caracaras (*Polyborus*) (Brown and Amadon, Eagles, Hawks and Falcons of the World, Vol. 2, McGraw-Hill, New York, New York, 1968; pers. obs.). In contrast, bilateral (double) scratchers displace the litter in a backward jump using both feet simultaneously, e.g., in many American emberizines (Greenlaw, Condor 79:426–439, 1977). Bill-sweepers such as jays (*Cyanocitta*) and thrashers (*Toxostoma*) move litter with sideways sweeps of the bill (Clark, Wilson Bull. 83:66–73, 1971).

At least two avian genera employ either bill-sweeping or bilateral scratching. Egyptian Plovers (*Pluvianus aegyptius*) use bilateral scratching and bill-sweeping at different times