3.88, df = 1) than was actually found, for a survival rate of only 72% per year is indicated by the 1977–1981 data. Either survivorship of the species decreased on the island, or very old birds have depressed survival rates.

Loss of 8 of the 9 oldest birds (banded 1963–1966) is noteworthy, as only 5 should have been lost between 1977 and 1981 under a survival rate of 81% per year. However, 20 of 29 birds banded 1967–1970 (survivorship, 75% per year) were also lost between 1977 and 1981. The difference in 1977–1981 survival between birds banded 1963–1966 and ones banded 1967–1970 is not significant ($\chi^2 = 1.7$, df = 1).

Reanalysis of 1960–1970 data on birds of known age (from Willis 1974) showed no significant annual differences in survivorship for males known to be 1–2, 3–4, 5–6, or 7–8 years old (213 of 244 individuals, or 87%, survived to the following year), but females 1–2 years old (98 of 126 individuals survived, or 78%) were significantly less likely to survive ($\chi^2 = 4.25$, df = 1) than were females 3–6 years old (55 of 61 were alive the next year, or 90%; 3 of 4 females 7–8 years old survived, too small a sample for tests). Females sit on nests at night, and may be unusually subject to predation when inexperienced at nesting; or there may be other causes of high mortality in females breeding for their first or second seasons.

I also analysed 1960–1970 data on birds banded as adults. Known-age males survived about like males banded as adults if the latter were banded 6 or fewer years before (238 of 286 survived, or 83%), but males of unknown age that had carried bands 7–10 y survived significantly less well (22 of 32 survived to a following year, or 69%; $\chi^2 = 4.13$, df = 1). The low survival of this group of very old males corresponds to the low survival of old males a decade later, and suggests that low survivorship of old birds was one cause of the high losses between 1977 and 1981. However, females banded as adults of unknown age in 1960–1970 showed little change in survivorship with increasing time since banding, except that only 6 of 8 females that had been adults 9–10 years earlier survived to the next year; the survivorship of females banded 1–6 y previously (193 of 245 surviving, or 79%) is not significantly different from that of females banded 7–10 y earlier (20 of 25 survived, or 80%). If adult birds are banded at unknown ages, and old birds survive less well than do younger ones, old birds will die too early in a study and will lower average survivorship at that time to levels where small samples might fail to detect differences. Possible high mortality of females 1–2 y old would be masked by including better-surviving females 3–6 y old with them, also.

In two cases, very old males sang little and wandered without mates when last seen, while their former mates were with younger birds. Such unmated males are not known to help relatives, and extended postreproductive life is probably not normal for the species. Barro Colorado has lost many species of predators (Willis 1974), some of which must have removed adult antbirds. Return of 1–2 individuals of one such predator to the island from 1970 on (the forest-falcon *Micrastur semitorquatus*; see Willis and Eisenmann 1979, Smithson. Contrib. Zool. 291:1–31) may partly explain high loss rates of Spotted Antbirds in 1977–1981, although depressed survivorship of old birds is even more likely.

I appreciate the support of the Smithsonian Tropical Research Institute for studies in 1977 and 1981, and of the University of Miami for a grant for air travel. Nick Brokaw provided observations of banded antbirds, and Yoshika Oniki helped at several stages.—EDWIN O. WILLIS, *Departamento de Zoologia, Universidade Estadual Paulista, Caixa Postal 178, 13500 Rio Claro, SP, Brazil.* Received 19 Aug. 1982; accepted 9 Aug. 1983.

Chickadee, Thrasher, and other Cowbird Hosts from Northwest Iowa.—I recorded 2 unexpected hosts of the Brown-headed Cowbird (*Molothrus ater*)—Black-capped Chickadee (*Parus atricapillus*) and Brown Thrasher (*Toxostoma rufum*)—while at Iowa Lakeside Laboratory, Dickinson Co., Iowa. I give details of these observations below as well as my observations of other cowbird hosts during 1982 and 1983 at Iowa Lakeside Laboratory and nearby Cayler Prairie and the Freda Haffner Kettlehole Preserve.

Black-capped Chickadee.—From 21 June to 29 June 1982, I monitored a pair of Black-capped Chickadees which apparently had reared 3 cowbirds and 1 of their own young. I first heard the calls of a young cowbird the morning of 21 June. I searched for and found

the cowbird and saw it fed by chickadees. One of the pair did most of the feeding and was easily identified since its regrowing rectrices were only half normal length. The other adult was with a young chickadee. Later that afternoon, I saw 2 young cowbirds with the family group and while I watched, a Common Grackle (*Quiscalus quiscula*) chased 1 cowbird short distances through the trees 3 times. The cowbird flew and maneuvered well. On 24 June, I saw 2 cowbirds with the short-tailed chickadee and another cowbird with the other adult host. On this date the group was 100 m from the area in which I first saw them.

Friedmann (1963, 1966, Friedmann et al. 1977) knew of 6 instances of cowbird parasitism on Black-capped Chickadees: 2 of these instances mention cowbird young: Packard (1936) watched chickadees rear 2 cowbirds to age 10 days before he removed them, and Root (1961) observed chickadees feeding a fledged cowbird. The paucity of parasitism records reflects the fact that chickadees nest in cavities, sites usually protected from cowbird parasitism, rather than chickadees being undesirable to cowbirds as hosts. The chickadee pair I observed was successful in rearing 3 cowbirds at least to age 20 days.

Brown Thrasher.—On 4 July 1982, I heard a young cowbird and found this bird in a Brown Thrasher's nest. Besides the 20 g cowbird, the nest contained 2 Brown Thrasher young (50 g and 46 g). All birds were well feathered and ca. 5–6 days old. After banding I had some difficulty in returning the cowbird to the nest since it continued trying to escape. On my next visit to check the nest (6 July), the young birds were gone, but the adult thrashers remained nearby scolding.

Friedmann's (1963, Friedmann et al. 1977) compilations list 79 records of cowbird parasitism on Brown Thrashers, of which 6 mention cowbird young. Baird et al. (1875) and Moore (1956) reported thrashers feeding fledged cowbirds. Nickell (1955) described 3 nests: a nest with 3 thrashers and a cowbird (which died at age 4 days); a nest from which 2 thrashers and 1 cowbird left; and a nest which possibly produced 4 thrashers and 1 cowbird. Elliott (1978) found 1 thrasher nest from which 3 thrashers and 1 cowbird survived. Taylor and Goertz (1965) describe an additional thrasher nest in which 2 cowbirds survived 2 days in the presence of 3 thrashers.

Other hosts.—I noted 32 cases of parasitism among 98 Red-winged Blackbird (*Agelaius phoeniceus*) nests that were found both summers. One parasitized nest was only a partially built platform. I found cowbird eggs in 1 abandoned nest and in 2 nests from which young had already left. Cowbirds were reared in 6 nests. The numbers of young reared in each nest are as follows: 2 Red-wing and 2 cowbirds, 1 Red-wing and 1 cowbird (2 times), 3 Red-wing and 1 cowbird (2 times), and 4 Red-wing and 1 cowbird. Successful incubation occurred at one nest with 3 Red-wing and 5 cowbird eggs. I found the nest on 10 June 1983 when it held 2 eggs and 1 young of the host and 2 eggs and 3 young of cowbirds. In testing nest defense of potential cowbird hosts, Folkers (1982) found parasitized Red-wing pairs at Iowa Lakeside Laboratory gave statistically less intense responses to cowbird models than did non-parasitized pairs. No doubt this lower aggressiveness in nest defense enhanced the likelihood of successful parasitism. Whether these behavioral differences relate to past breeding experience of these birds, as suggested by Robertson and Norman (1976), or to other factors, is unknown.

Seven of the 20 Yellow Warbler (*Dendroica petechia*) nests I found were parasitized. One nest, an abandoned, partially built platform, contained a cowbird egg sticking through the bottom. In 1983, I found 3 nests with buried cowbird eggs: 2 buried cowbird eggs and 2 warbler and a cowbird egg in the top cup; 2 buried cowbird eggs, a second buried level with 5 warbler and 1 cowbird egg, and a single warbler egg in the top cup; and 2 buried cowbird eggs and 2 warbler and 2 cowbird eggs in the top. From this last nest, 1 warbler and 2 cowbirds left the nest. Three other warbler nests produced cowbird young: 2 warblers and 1 cowbird; and 1 warbler and 1 cowbird (twice). Of 62 Yellow Warbler nests monitored in 1938–1940 at Iowa Lakeside Laboratory (Kendeigh 1941, Schrantz 1943), 15 contained cowbird eggs and for all but 1 of these parasitized nests the cowbird egg had been buried in the nest lining.

All 3 Willow Flycatcher (*Empidonax traillii*) nests I found were parasitized. The history of 1 nest permits the timing of 1 cowbird visit. On 18 June 1982, the nest contained 3 flycatcher eggs and 1 cowbird egg; on 19 June, 2 flycatcher eggs and 1 cowbird egg; on 20 June at 1000, 1 flycatcher egg and 3 cowbird eggs. Four hours later, the last flycatcher

egg was gone. The nest was destroyed by a predator 2 days later. Mayfield (1960:160) stated that cowbirds usually remove eggs before 0900, but Nolan (1978:375) noted 1 egg removal that occurred after 1000.

Both of the Dickcissel (*Spiza americana*) nests I found were parasitized. In 1 of these, cowbird eggs were buried. This nest was found on 14 June 1983, still under construction. The next day there was 1 cowbird egg in it; on 17 June, 2 cowbird eggs. On 21 June these eggs had been buried as well as an additional cowbird egg and 1 Dickcissel egg in a second level; the third level of the nest had 2 Dickcissel eggs. One cowbird egg was added to the top level between nest checks on 22 June and 25 June. On 29 June, these top eggs had been spiked. Friedmann (1963:36) did not include Dickcissels in his list of species known to bury cowbird eggs. John L. Zimmerman (in litt.) has not found buried cowbird eggs among the "several hundred" Dickcissel nests he has seen.

One of 3 Bobolink (*Dolichonyx oryzivorus*) nests was parasitized. When I found this nest on 7 June 1983, the nest had 6 Bobolink eggs and 10 cm from the nest was a cowbird egg. After Bobolink young left the nest, I found 2 additional cowbird eggs in the nest (on 21 June and 25 June); 1 young Bobolink remained 30 cm from the nest during this same time.

Other cowbird hosts I recorded included Song Sparrow (*Melospiza melodia*), Grasshopper Sparrow (*Ammodramus savannarum*), Common Yellowthroat (*Geothlypsis trichas*), and Eastern Kingbird (*Tyrannus tyrannus*). The cowbird egg in the kingbird nest was removed, an expected observation (Rothstein 1975), and the nest abandoned. Of these last 4 species, I saw only Song Sparrows with out-of-nest cowbirds.

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Comparative Implications of Bathing by a Willow Flycatcher.—Comparative studies have tended to focus on reproductive and foraging behavior with few comparative studies of maintenance behavior. Because it is sequentially isolated (Slessers, Auk 87:91–99, 1970; Burtt and Hailman, Ibis 120:153–170, 1978), maintenance behavior is difficult to study systematically. However, I observed a sequence of bathing by a Willow Flycatcher (*Empidonax traillii*) that, although anecdotal, suggests a number of functional comparisons with bathing behavior of other insectivorous birds, in particular swifts (Apodidae), swallows (Hirundinidae), and wood warblers (Parulinae).

At 2005 on 8 July 1981 I observed a Willow Flycatcher perched on a dead branch 2.5 m above the edge of a small pond in the Delaware Wildlife Refuge, Delaware, Ohio. From its perch the bird flew 3 m horizontally out over the pond then dropped at a 60° angle to the water which it entered breast first with a splash. While descending, the wings were fluttered about 60° above the horizontal, the feet hung down, and the tail was raised about 30° and fanned. At the time of entry into the water, the plumage was ruffled and the head raised. The bird dragged its body about .5 m through the water on raised, rapidly beating wings, then rose steeply, turned 180°, and flew in a straight line back to its perch where it landed and remained back to the sun. It shook its wet, ruffled plumage by rapidly rotating the body back and forth around the long axis, starting with the head and finishing with rapid shaking of the wings. The bird preened feathers of the back and breast, head-scratched over the wing once, then turned to face the sun and took off on the same flight path as before, repeating the entire process 4 more times. The last 2 flights took 4 and 4.1 sec and were separated by an interval of 13 sec.

The bathing behavior of wood warblers, swifts, and swallows, like that of the Willow Flycatcher, is organized into bouts of splashing alternating with intervals of shaking (Slessers, op. cit.; pers. obs.). However, warblers stand in shallow water throughout bathing, flying to a nearby perch only after the last bout of splashing (Slessers, op. cit.; pers. obs.). The Willow Flycatcher, like warblers, was non-aerial between bouts of splashing. Unlike warblers it perched away from the water when shaking and included preening and head-scratching between bouts of splashing. Swallows and swifts bathe by gliding across the surface of the water with the body in the water, the wings set at about 60°, and the tail raised and fanned (Slessers, op. cit.; pers. obs.). Just prior to rising from the water, the swallow or swift resumes flapping. After wetting the body, the swallow or swift shakes in flight and may even preen and head-scratch, before dipping into the water once again. After the last glide through the water, the swallow or swift may perch and shake, preen, and head-scratch. Like swallows and swifts and unlike warblers the flycatcher wet itself by flying with its body in the water and included preening and head-scratching between bouts of splashing. Unlike swallows and swifts the flycatcher's entry into the water was abrupt and the flycatcher beat its wings while its body was in the water, although the wings and tail were raised at about the same angle as those of gliding swallows and swifts. Unlike swallows and swifts, Willow Flycatchers do not shake, preen, or head-scratch while in flight. Thus the bathing behavior of Willow Flycatchers appears to be more aerial than that of warblers, but less aerial than that of swifts and swallows. Similarly the foraging behavior of Willow Flycatchers is more aerial than that of warblers, but less aerial than that of swifts and swallows. Adaptations to aerial foraging may be associated with aerial performance of maintenance behavior. Whether or not maintenance behavior can be performed while airborne probably depends on the efficiency of flight. Reduced predation may be the advantage of remaining airborne during maintenance behavior (Simmons, *in* A New Dictionary of Birds, Thomson, ed., McGraw-Hill, New York, 1964). Whatever the reason behind the association between the mode of foraging and bathing, interspecific variation in avian bathing behavior is considerable (Slessers, op. cit.) and deserving of functional study.

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