COWBIRDS IN THE CAROLINAS

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Abstract.—The first fledgling Brown-headed Cowbird was seen in the Carolinas in 1933. Since that time the species has been reported during the breeding season from all sections of the two states, although it appears at present to be generally more numerous in North Carolina and western South Carolina than in eastern South Carolina. Rufous-sided Towhees, Red-eyed Vireos, Solitary Vireos, Wood Thrushes, Dark-eyed Juncos, and Chestnut-sided Warblers are the most frequently reported of the 29 host species recorded in the Carolinas. Host selection and egg-laying behavior have been well studied in the Brown-headed Cowbird, but much remains to be learned about the development of the young, particularly in regard to the relationship of the fledgling to the natural mother.

One of the first things the beginning bird student learns is that cowbirds lay their eggs in the nests of other birds. The tendency is to assume that cowbirds are not nice and to ignore them except when another species is needed for the local bird count. Nevertheless, these birds warrant our careful attention. The purposes of this paper are to review the history of the Brown-headed Cowbird (*Molothrus ater*) in North and South Carolina, to assess the present status of the species in the region, and to summarize the breeding habits of this brood parasite.

METHODS

A survey of records published in the two state bird books as well as in *Chat* and *American Birds* provided the early history of the cowbird in the Carolinas. From these sources and unpublished records, both our own and those of Carolina Bird Club members who responded to a request for information in *Chat,* we obtained data on 101 known cowbird eggs or young for the region. The great majority of these reports were sightings of hosts feeding fledgling cowbirds. Whitehurst's data are from her yard in a residential section of Raleigh, Wake County, N.C., where she feeds the birds regularly throughout the year. Potter's data are from her wooded yard adjacent to a golf course in rural eastern Wake County, 4.5 miles N of Zebulon, N.C. Additionally, Potter conducted field studies in southern Franklin County, N.C., which is the portion adjacent to eastern Wake County. She made 80 trips between 1 October 1975 and 30 September 1976. There are several large cattle farms in southern Franklin County, and each trip included a visit to one or more of these sites. Material on nesting habits is mostly from the general literature, but some details are based on personal observations of the authors and various other CBC members.

HISTORY OF COWBIRD BREEDING IN THE CAROLINAS

Although Brown-headed Cowbirds have long been known as winter residents in the Carolinas, the first positive evidence of egg laying was not found here until 1933. On 10 June 1933 someone brought Thomas D. Burleigh a week-old cowbird taken from a Red-eyed Vireo nest in Buncombe County, N.C. (Pearson et al. 1959, p. 355). On 17 July 1934 an unidentified warbler was seen feeding a cowbird fledgling at Clemson, S.C. (Sprunt and Chamberlain 1970, p. 506). In June 1939 immature cowbirds were noted at Hatteras village and Oregon Inlet (Pearson et al. 1959, p. 355). Evidence of breeding in central North Carolina came from Greensboro in 1943 (Chat 7:79), Durham in 1958 (Chat 23:20), Mecklenburg County in 1958 (Chat 22:84), Chapel Hill in 1959 (Chat 23:68), and Nash County in 1965 (Chat 29:89). On the southern coast breeding was first

TABLE 1. Number of Brown-headed Cowbird fledglings seen by Whitehurst and Potter in Wake County, N.C., 1969-1978.

Year	*1969*	*1970*	*1971*	*1972*	*1973*	*1974*	*1975*	*1976*	*1977*	*1978*
Whitehurst[1]	1	1	1	2	3	5	3	8	3	5
Potter[2]	0	0	0	1	0	1	0	0	1	1
Total	1	1	1	3	3	6	3	8	4	6

[1]Yard in Raleigh residential neighborhood; summer bird feeding program.

[2]Yard in rural woodlands adjacent to golf course; no summer bird feeding program.

noted in Charleston County, S.C., in 1965 (Chat 29:115) and near Wilmington, N.C., in 1967 (Chat 31:99).

In the early years (1933 to mid-1950s) reports of cowbird eggs or young were few and far between in the Carolinas. Some observers believed that migrating females laid eggs and continued moving northward (Pearson et al. 1959, p. 355). Although instances of such behavior cannot be eliminated as a possibility, one adult female certainly remained at Clemson, S.C., at least until late June to lay the egg that produced the fledgling being fed on 17 July 1934 (Sprunt and Chamberlain 1970, p. 506). Repeated sightings of adults and young in June, July, and August soon made it obvious that adult Brown-headed Cowbirds were remaining in the Carolinas all summer and that females were continuing to lay eggs well into July.

The second report of confirmed breeding did not come from Clemson until May 1957 (Chat 21:90); however, Gaston Gage (pers. comm.) indicates that cowbirds were present there throughout the summer of 1953, with 5 adults seen on 29 May, 5 adults on 26 June, 14 adults on 9 July, about 50 adults on 11 July, 2 immatures on 20 July, and about 15 (age not specified) on 5 August. Gage saw about 30 cowbirds, including some immatures, on 11 July 1954. Thus it is apparent that the cowbird breeding population was already well established in the Clemson area at the time of the 1957 report.

By the mid-1960s the species was parasitizing nests throughout the Carolinas, though it was still locally scarce or absent in the eastern piedmont and inner coastal plain. Wake County provides a good example of how unobtrusive cowbirds can be during the early years of local egg laying. Fifty cowbirds were reported on a bird count at Raleigh on 28 April 1956 (Chat 20:54). This suggests the probability of local breeding because Brown-headed Cowbird flocks disperse in late winter or very early spring (Bent 1958, p. 448-449). However, the first reported summer sighting of adult cowbirds did not occur until 26 and 27 June 1962 when Oliver H. Orr Jr. saw a male and a female at his home near Raleigh (N.C. State Museum records). Summer adults were first noted at Zebulon on 18 June 1966 when Potter saw two females and four males displaying on a green at the Zebulon Country Club. The first positive evidence of breeding in Wake County came in 1968 when R.J. Hader saw a juvenile following an adult Rufous-sided Towhee at Raleigh (Chat 32:81). Table 1 shows the number of cowbird fledglings seen each of the 10 years following 1968 by Whitehurst in Raleigh and by Potter in rural Wake County. In spite of the expected seasonal variations in nesting success and observer diligence, the general trend is decidedly upward.

J.H. Carter III (pers. comm.) says that cowbirds did not spend the summer in the Southern Pines area when he first became interested in birds in the mid-1960s. First, males began to linger into June. Then immatures began to appear in July and August, and adults of both sexes also began to show up in these months. By 1971 the species had

TABLE 2. Taken from computer print-outs of summary sheets for U.S. Fish and Wildlife Service Breeding Bird Survey Routes run in North Carolina from 1966 through 1978, the data below for routes run at least four times from 1966 through 1977 show 12-year means for two common cowbird hosts, the Rufous-sided Towhee and the Red-eyed Vireo, compared with the mean for the Brown-headed Cowbird. The cowbird mean is compared with the number of this species found on the same route in 1978. County designation applies to the starting point for each route, although some routes are known to extend into other counties. The number in parentheses following the county name indicates how many years that particular route was censused from 1966 through 1977.

Route	*Rufous-sided Towhee mean*	*Red-eyed Vireo mean*	*Brown-headed Cowbird mean/1978 total*
MOUNTAIN REGION			
Craven Gap, Buncombe (7)	21	3	3/ –
Fontana, Swain (4)	14	43	1/ 1
Cullowhee, Jackson (4)	28	32	8/13
Brevard, Transylvania (10)	22	11	2/ 1
NORTHERN COASTAL REGION			
Grandy, Currituck (5)	7	3	15/ --
Mashoes, Dare (7)	43	1	25/ --
WESTERN PIEDMONT REGION			
Copeland, Surry (10)	28	4	9/ 5
Call, Wilkes (8)	16	18	2/23
Mooresville, Iredell (4)	26	25	10/ 9
Climax, Guilford (12)	13	12	3/ 1
Madison, Rockingham (12)	21	2	3/ –
Saxapahaw, Alamance (12)	14	15	4/ –
SOUTHERN COASTAL REGION			
Merrimon, Carteret (10)	11	3	4/10
Ward's Corner, Pender (7)	40	8	1/ –
Myrtle Grove, New Hanover (11)	27	1	4/11
Shallotte, Brunswick (10)	35	6	2/18
EASTERN PIEDMONT REGION			
Arcola, Warren (7)	32	27	7/14
Youngsville, Franklin (12)	30	14	4/ 5
Jordan, Johnston (12)	23	8	3/ 0
INNER COASTAL PLAIN			
California, Hertford (5)	35	52	11/35
Beargrass, Martin (12)	19	3	2/ 2
Speed, Edgecombe (12)	18	9	1/ 6
Rosewood, Wayne (10)	11	4	1/ 0
Kinston, Lenoir (4)	11	2	2/ 2
Arapahoe, Pamlico (12)	28	5	4/ 6
Fairmont, Robeson (10)	21	4	2/ 0

become a permanent resident, though uncommon in summer and rare in midwinter (Carter 1971).

In North Carolina 26 U.S. Fish and Wildlife Service Breeding Bird Survey Routes have been run at least four times during the 12-year period from 1966 through 1977. The

mean number of cowbirds for each of these routes is given in Table 2 along with the number of individuals reported in 1978. The highest cowbird means are from the Mashoes route in Dare County (25) and the Grandy route in Currituck County (15), both of which lie in the northeastern coastal region where the cowbird can be assumed to have been breeding more than 40 years. Cowbird means for the four mountain routes are surprisingly low, and probably are not typical of mountain localities having extensive agricultural development.

A 1977 report on the breeding birds in South Carolina State Parks (Chat 42:71-72) shows cowbirds to be present at 11 of the 14 units censused. The species was most numerous at Croft in Spartanburg County (18 birds), Huntington Beach in Georgetown County (8 birds), and Oconee in the mountains (5 birds). One to four cowbirds were at the other units reporting the species. Although cowbirds were found in all sections of South Carolina, they were encountered less frequently at parks in the southern portion of the coastal plain than elsewhere in the state.

PRESENT STATUS

From the various reports cited above, however scattered and fragmented they may be, we can see that the Brown-headed Cowbird extended its breeding range throughout the Carolinas during the 40 years between 1930 and 1970. During the 1970s the cowbird breeding population seems to have stabilized at a relatively low level in the regions first invaded (mountains, western piedmont, northeastern North Carolina) while an upward trend continued in recently invaded regions (eastern piedmont, southern coast, inner coastal plain). Today the Brown-headed Cowbird is generally fairly common throughout the Carolinas during the egg-laying season, but it remains locally scarce, perhaps even absent, in certain portions of the coastal plain. Although a long-term increase in the total cowbird breeding population in the Carolinas seems inevitable, this species shows no signs of ever becoming as numerous as the Starling and House Sparrow.

NESTING HABITS

Formerly a bird of the grassy plains of mid-North America, the Brown-headed Cowbird followed herds of bison and other wild grazing animals prior to the introduction of domestic cattle. The species gradually extended its range eastward and westward as the forests were cut and increased areas of cleared land were used for crops and pastures. No one can tell whether brood parasitism evolved as an adaptation to the species' feeding habits or simply made it possible for the Brown-headed Cowbird to occupy a previously vacant feeding niche. Whichever came first, the feeding strategy or the reproductive strategy, the system obviously works well for the Brown-headed Cowbird even though this species has none of the special adaptations (such as egg mimicry) characteristic of certain other brood parasites, most notably the Common Cuckoo (*Cuculus canorus*) of Eurasia and Africa.

Habitat requirements.—Although a few Brown-headed Cowbirds may feed and breed in the rather limited natural grasslands of eastern North America (e.g. grassy mountain balds, coastal marshes), the vast majority depend on man-made and man-maintained open areas such as pastures and golf courses. During the egg-laying season, many cowbirds also frequent woodland edges and residential neighborhoods with lots of shade trees. Here the female—usually accompanied by one or more males—perches in a tree, often a standing dead tree, that offers a clear view of the nesting activities of potential hosts. A good observation post appears to be essential to her success in locating nests suitable for parasitizing.

Working in the Otter Lake region of Michigan, the McGeens (1968) found that one female may cover from 12 to 40 acres, with a probable average of 25 acres. Overlapping

ranges are not uncommon. Apparently the density of the cowbird population is relative to the number of host nests available per female cowbird.

Although there is no support from observations of banded birds, two Carolinians describe behavior that indicates strong site loyalty in breeding cowbirds. In June 1979 at Pendleton, S.C., Pamela M. Spencer noted in her yard a male cowbird that spent his time, when not feeding, perched atop a weather thermometer attached to the window of the house. He used the thermometer to wipe his bill after feeding, and he repeatedly displayed from this perch. The female perched in a large oak tree nearby. In March 1980 a pair of cowbirds arrived, the male perching regularly on the thermometer and the female in the same oak tree.

At Raleigh in the summer of 1979, Whitehurst had five young cowbirds that followed her about the yard, begging for food. Among the adults arriving in the spring of 1980 was one that immediately began following her and begging for food. Whitehurst strongly believes that one of the birds reared in the vicinity of her feeder in 1979 returned to the same area to breed in 1980.

Host species.—Herbert Friedmann, author of *The Cowbirds: A Study of the Biology of Social Parasitism* (1929), periodically summarizes data on cowbird host relations (Friedmann 1963). His most recent updating (Friedmann 1971) brings the total number of species parasitized by the Brown-headed Cowbird to 214, of which 121 are known to have reared cowbirds. Obviously many of the hosts are rare or accidental, and some of them (e.g. Mourning Dove, Purple Martin) have nesting habits that make them unsuitable foster parents for young cowbirds.

The Brown-headed Cowbird is the only regular brood parasite that is widely distributed in the parts of North America north of Mexico. Although its hosts range in size from the Blue-gray Gnatcatcher to the Mourning Dove, Lowther (1979) indicates that eggs of commonly used host species are generally smaller and less heavily marked than cowbird eggs. Egg size (volume) appears to be the most important visual cue for nest selection by female cowbirds. Some females show a strong preference for laying in the nests of a single species (McGeen and McGeen 1968) whereas others may parasitize the nests of several species. Among the birds most frequently victimized are vireos, tanagers, *Hylocichla* thrushes, and many warblers and fringillids.

Of the 29 host species recorded in the Carolinas, the one most frequently reported is the Rufous-sided Towhee (25%). This probably is a disproportionately large percentage because the towhee nests in residential neighborhoods and is more likely than most other host species to bring the fledgling cowbird to a bird feeder. Following the towhee are the Red-eyed Vireo (15%), Solitary Vireo (9%), Wood Thrush (8%), Dark-eyed Junco (6%), and Chestnut-sided Warbler (5%). No other species has been reported more than three times: Carolina Chickadee, Blue-gray Gnatcatcher (3), White-eyed Vireo, Yellow-throated Vireo, Black-and-white Warbler (2), Swainson's Warbler, Worm-eating Warbler, Northern Parula, Yellow-throated Warbler (2), Pine Warbler (2), Prairie Warbler, Ovenbird, Kentucky Warbler, Common Yellowthroat, Yellow-breasted Chat, American Redstart (2), Cardinal (2), Blue Grosbeak (2), Indigo Bunting, Painted Bunting, House Finch, Chipping Sparrow (2), and Field Sparrow. The six most frequently reported hosts account for 68% of the Carolina records; the remaining 23 species account for only 32%.

Most of the hosts are widespread and multi-brooded in the Carolinas. The House Finch, however, is a newcomer to the region and not yet known to breed in large numbers. It apparently nested in Winston-Salem for the first time in 1974 (Chat 38:98). By 1978 the species was nesting at several locations, and cowbird parasitism was noted in the small colony at Salem Cemetery (Chat 42:74-75).

Although conclusive data are not available for the Carolinas, the very small number of reports of more than one cowbird egg per nest (2) or of host pairs feeding more than one fledgling (5) suggest that only a small proportion of the parasitized nests

contain more than one cowbird egg. However, such a small percentage of our data comes from examination of active nests that we could very easily be misled by the sample. There may be a high failure rate in nests containing two or more alien eggs.

In general, the large and medium-sized hosts (e.g. towhees and vireos) are more successful than the small ones when it comes to fledging young cowbirds. Nonetheless, Tom Haggerty (pers. comm.) reports a Chestnut-sided Warbler feeding three young cowbirds in Watauga County on 10 July 1979. Fortunately, cowbirds tend to victimize common, multi-brooded species whose open nests are easy to find. This habit apparently insures an abundance of suitable foster parents in future breeding seasons. The only time the cowbird becomes a very serious problem for a host species is when a small total population happens to be concentrated in a small geographic region, as is the case with the Kirtland's Warbler. This rare and endangered species is now protected by systematic removal of adult cowbirds and cowbird eggs. Most host species can take the inconvenience of rearing cowbirds in stride. One study indicates that the difference in nesting success between parasitized and nonparasitized populations may be as little as 3% (Pettingill 1970, p. 378). Nevertheless, Carter (pers. comm.) believes cowbird parasitism had an adverse effect on Solitary Vireos breeding in the Sandhills, where that species is at or near the eastern edge of its range in the Carolinas.

Table 2 shows the 12-year mean for cowbirds found on certain North Carolina Breeding Bird Survey Routes compared to the 12-year means for Rufous-sided Towhees and Red-eyed Vireos. At almost all localities the towhees and vireos are present in much greater numbers than are the cowbirds, indicating an abundance of suitable hosts. Only in northeastern North Carolina (Grandy) does the mean number of cowbirds exceed the combined means for the two most commonly reported host species statewide. Merrill Lynch (pers. comm.) suggests that where the Rufous-sided Towhee and Red-eyed Vireo are relatively uncommon, the Brown-headed Cowbird relies on one or more locally common hosts not frequently parasitized elsewhere in the state. This is a good hypothesis because we can easily see that cowbirds parasitizing Dark-eyed Juncos and Chestnut-sided Warblers in the mountains are showing preference for locally common species that do not breed in the piedmont and coastal plain.

Mengel (1965) lists 23 cowbird hosts for Kentucky. More than 20% of the nests examined had been parasitized in six species: Summer Tanager (41.2% of 17 nests), Red-eyed Vireo (36.3% of 11), Indigo Bunting (32.5% of 40), Wood Thrush (28.2% of 39), White-eyed Vireo (25.0% of 8), and Field Sparrow (22.4% of 49). Mengel found the Red-eyed Vireo to be the most successful host in terms of the number of young cowbirds known to have been fledged, followed by the Indigo Bunting, Summer Tanager, Wood Thrush, Cardinal, and Field Sparrow.

Southern and Southern (1980) found that some species remain locally common in spite of having been heavily parasitized for almost 70 years. Their recent study of nesting data from the University of Michigan Biological Station (UMBS), a largely forested preserve situated in Cheboygan and Emmet Counties in the northern portion of the Lower Peninsula, provides data on cowbird parasitism for a single region for a period of 68 years (1911-1978). The Southerns selected 2605 adequately detailed nest records from UMBS files. These represented 57 open-nesting passerines considered to be potential cowbird hosts. No nest parasites were recorded for 26 of these species, but the remaining 31 were parasitized at least once between 1911 and 1978. Of those species with a sample size larger than 10 nests, 13 had more than 20% of the recorded nests parasitized. The Red-eyed Vireo, with 69.3% of 257 nests parasitized, was the most frequent host at UMBS. It was followed by the Scarlet Tanager (63.64% of 11 nests parasitized), Chestnut-sided Warbler (52.94% of 17), Veery (51.52% of 33), Indigo Bunting (43.24% of 37), Purple Finch (42.11% of 19), Yellow-rumped Warbler (36.84% of 19), American Redstart (35.71% of 42), Ovenbird (29.55% of 44), Yellow Warbler (28.57% of 21), Chipping Sparrow (24.54% of 216), Rufous-sided Towhee (24.14% of 29), and Hermit Thrush (21.67% of 60).

Comparison of the Carolina, Kentucky (Mengel 1965), and UMBS (Southern and Southern 1980) data with each other and with results of other studies reveals some marked variations that appear to be related to (1) local habitat or (2) regional species diversity and relative abundance. In general, the more specialized and uniform the habitat, the lower the species diversity and thus the more heavily parasitized the limited number of suitable hosts within the area.

For example, a study of cowbird parasitism in northeastern Kansas (Elliott 1977) indicates that Grasshopper Sparrows, Dickcissels, and Eastern Meadowlarks nesting on the ground in this prairie region experienced a combined incidence of 70% parasitism with a mean of 2.7 cowbird eggs per parasitized clutch. Only 26% of the parasitized nests had but one cowbird egg. This contrasts sharply with data from other regions showing that approximately 60% of the parasitized nests have only one cowbird egg. Both Grasshopper Sparrows and Eastern Meadowlarks are on the list of birds for which no parasitized nests were reported at UMBS. Neither of these species has been recorded as a host in the Carolinas or Kentucky. (Dickcissels, of course, are irrelevant to the present study because of their rarity as breeding birds in the eastern United States.)

During a study of cowbird parasitism in an abandoned pasture and adjacent wet thicket at Otter Lake near Pontiac, Michigan, the McGeens (1968) found the Yellow Warbler to be the preferred host with some female cowbirds apparently laying exclusively in the nests of this species. The Yellow Warbler was a fairly common host at the largely forested UMBS, but we have no record of it as a host in Kentucky or the Carolinas.

Although Klass (1975) found cowbirds had parasitized 24.3% of 391 Eastern Phoebe nests he studied in Kanasas, this host was not reported at UMBS (97 nests examined) or in the Carolinas. In Kentucky, Mengel (1965) examined 32 nests and found only three (9.4%) that contained a single cowbird egg or nestling. Data from Connecticut and Michigan (Rothstein 1975) indicate 20.6% of 136 phoebe nests were parasitized by cowbirds.

There is no record of a parasitized Red-winged Blackbird nest from the UMBS (44 nests examined), Kentucky, or the Carolinas, but Hergenrader (1962) reported 54.2% of 59 nests examined in Nebraska contained one to three cowbird eggs.

Considering the Song Sparrow's reputation as a common host for cowbirds, the rates at UMBS (4 of 61 nests parasitized, 6.56%), in Kentucky (2 of 25 nests, 8%), and in the Carolinas (only one report in the 101 documented) are surprisingly low.

Mengel (1965) reported the Summer Tanager as the species most frequently parasitized in Kentucky (14 cowbird eggs or young in 7 of 17 nests examined), and the Southerns (1980) found 7 of 11 Scarlet Tanager nests parasitized at UMBS. However, neither species has been reported as a host in the Carolinas.

The most frequently reported host in the Carolinas is the Rufous-sided Towhee (25% of the documented eggs or young). At UMBS 7 of 29 nests (24.14%) were parasitized, indicating that the towhee is an important host in that part of Michigan, though far from the most frequent one. In Kentucky only 2 of 20 towhee nests (10%) contained cowbird eggs or young. Thus the towhee ranks twelfth at UMBS and sixteenth in Kentucky according to the percentage of parasitized nests in samples of 10 or more nests examined. The Carolina sample may be biased toward Rufous-sided Towhees because they bring young to feeders, and our data based mostly on fledglings are not comparable to the nest records from Kentucky and Michigan; nevertheless, the towhee appears to be a far more frequent host in the Carolinas than in Kentucky and Michigan.

While acknowledging the reality of sample bias, we believe that most, if not all, of the regional variations in the rates of cowbird parasitism noted above reflect real differences in host selection. The Southerns suggest, and the present authors concur, that host species diversity and relative abundance contribute to regional differences in

host selection. It seems apparent, though, that host selection is governed by something more subtle than mathematical probability when several species that are common and successful hosts elsewhere have not yet been recorded as hosts in the Carolinas even though they are common and widely distributed breeding birds in this region.

Egg-laying behavior.—Pettingill (1970, p. 361) summarized the egg-laying behavior of the female Brown-headed Cowbird. Having noticed the nest under construction, she usually does not enter it until the prospective foster mother has laid two or more eggs but still has not begun incubating them. About a half hour before sunrise is the normal time for the female cowbird to enter the unoccupied nest and quickly deposit a single egg. No egg of the host species is destroyed at this time. Egg removal takes place the day before laying, later in the day of laying, or the day after laying. The female then pierces the egg with her bill, carries it from the nest, and eats it. Her interest in the nest continues, and she may remove additional eggs or, rarely, even the young of the host if she is allowed to approach the nest.

Normally the female cowbird deposits one egg a day for several consecutive days. In a given season 10 to 12 eggs may be laid in several "clutches" of 1 to 6 eggs each, with intervals varying from several days to a few weeks (Pettingill 1970, p. 361). However, the figures cited by Pettingill may be on the conservative side. The McGeens (1968) noted that the laying cycle varied from year to year with the host cycles. Their egg data from the Otter Lake region of Michigan suggest single female cowbird cycles of 18, 19, and 25 eggs in 4 to 7 clutches over periods of 40, 41, and 70 days.

Nests containing more than one cowbird egg may have been parasitized by more than one female, and Bent (1958, p. 438) reports that as many as eight cowbird eggs have been found in a single towhee's nest. Lowther (1979) indicates that the relatively large size of cowbird eggs seems to protect them from removal by female cowbirds that subsequently lay in the same nest.

Rejector species.—Birds have three primary defenses against brood parasitism: nest desertion, puncture or removal of the alien egg, the construction of a new nest on top of the old one. Blue Jays, Eastern Kingbirds, Cedar Waxwings, Gray Catbirds, Brown Thrashers, and American Robins are among those that puncture and eject cowbird eggs. The Yellow Warbler is well known for building many-layered nests to avoid incubating cowbird eggs (Pasquier 1977, p. 187). On 6 June 1971 Jay Carter (pers. comm.) found a Solitary Vireo nest containing one vireo egg and three cowbird eggs. After the nest was abandoned, he examined it and found a fourth cowbird egg that apparently had been roofed over by the nest builder. Sometimes unwilling hosts may bury the cowbird egg in the nest lining (Sprunt and Chamberlain 1970, p. 506).

Annual cycle.—In her study of the birds of Franklin County, N.C., Potter found that the large flocks of cowbirds depart or disperse in February. As early as 3 March she found cowbirds "on territory" at Zane's Mountain, a particularly attractive nesting place for good host species. Cowbirds were singing and displaying at three sites on 15 March, and on 29 March single birds and small flocks were at six places. On 15 April cowbirds were present at every creek and river bottom, and a few were at the cattle farms, too. Cowbirds appeared to continue feeding at the cattle farms even though they were searching woodland habitats for nests to parasitize. They were seen regularly along the watercourses from mid-April through June, but their numbers declined as the nesting season progressed. Meanwhile, the numbers found at the cattle farms increased until August when flocks of 20 or more immatures or 50 to 150 adults and immatures could be found in feed lots. Cowbirds were generally scarce in September and early October, giving the impression that most of the local breeding poipulation had moved south prior to the arrival of fall migrants from the north. However, it is very likely that some individuals are permanent residents in the Carolinas.

Nesting season.—Of the 101 known eggs or young cowbirds found in the Carolinas, we can calculate the month of laying for 53. These data indicate that the peak of laying occurs in June (43%). Approximately 34% of the eggs appear to have been laid in May with three of these possibly laid in very late April. The remaining 23% were laid in July, with one possibly laid in very early August. The earliest egg date we have seen for the Carolinas is 5 May at Charleston, S.C. (Chat 29:115); the earliest date for a young cowbird in the nest is 10 May in Moore County, N.C. (Chat 32:104); and the earliest date for a fledgling is 27 May (several sites). The latest date we have for a fledgling still dependent on the foster parent is 27 August (Whitehurst). The early May to late July period for egg laying is consistent with dates listed in Bent (1958, p. 450). As the McGeens (1968) point out, pooling egg dates from several seasons gives the impression of a longer laying period than is normal for a single season because varying weather conditions sometimes make onset of laying for hosts earlier or later than normal.

Incubation period.—According to Bent (1958, p. 439), the incubation period varies from 11 to 14 days with 11 to 12 being the usual number. The young cowbird normally hatches at least a day ahead of the young of the host species.

Nestling period.—Unlike some other brood parasites, young Brown-headed Cowbirds are not known to make a deliberate (or instinctive) effort to injure or oust the eggs or young of the foster parents. Although nestlings of the host species, particularly the larger ones, often are raised successfully along with the cowbird, smaller nestmates sometimes are undernourished or crowded out.

From a blind Tom Haggerty (pers. comm.) observed the care of a young cowbird in Watauga County, N.C., on 14 and 17 July 1979. At 1550 on 14 July, the female Indigo Bunting fed the young cowbird and took away the fecal sac in her mouth. The cowbird (eyes open, feathers emerging from sheaths) was larger and better developed than the single downy Indigo Bunting nestling, which still had its eyes closed. The inside of the cowbird's mouth was red; the bunting's mouth lining was yellow. The adult Indigo Bunting did not seem to distinguish between the two. The young cowbird kept its head and bill up, whereas the young bunting let its head drop. The cowbird was quicker to open its mouth for food, but it did not point its bill toward the approaching adult. Items fed to the cowbird were a butterfly and several grasshoppers.

At 0900 and 0905 on 17 July, Haggerty saw a female Chestnut-sided Warbler feed caterpillars to the cowbird nestling in the Indigo Bunting nest. At 0910 the female bunting came to the nest and seemed to look for fecal matter. The cowbird appeared to be alone in the nest. The warbler fed the cowbird eight times between 0922 and 1004. At 1009 the female Indigo Bunting returned to the nest, fed the cowbird, and settled on the nest. She left at 1013 and spent about 5 minutes chasing the Chestnut-sided Warbler from the nest. Meanwhile, a male Common Yellowthroat investigated the nest but did not bring food. At 1020 and 1030 the Chestnut-sided Warbler continued to feed the cowbird. Haggerty departed at 1031. Because the male Indigo was singing frequently and the female spent most of the period of observation on 17 July climbing around a Blackberry bush about 100 feet from the nest, Haggerty believes that she was in the process of constructing another nest.

Interspecific relationships such as a helper at the nest are always interesting, but few bird students ever match Haggerty's record of seeing four species at one nest, two of them feeding a nestling of a third species.

Fledgling period.—The rate of growth for the cowbird nestling depends on the suitability of the food furnished by the foster parents and the quantity provided (Bent 1958, p. 440-441). A lone cowbird grows faster than one that must compete with other nestlings. Thus, the age at which cowbirds leave the nest is subject to considerable variation; about 10 days may be a good average. The foster parent may continue to feed

the fledgling out of the nest for as long as 14 days. Potter has noted that fledgling cowbirds follow ground feeders such as Wood Thrushes and Rufous-sided Towhees about on the ground, whereas fledglings being fed by arboreal species such as Red-eyed Vireos and Blue-gray Gnatcatchers remain on elevated perches in trees or shrubs or atop tall fences.

Relatively little has been published on the care of young cowbirds after they leave the nest. On 30 June 1979, Potter heard a young cowbird calling from a perch in the canopy of a Sourwood (*Oxydendrum arboreum*). Tended by a Red-eyed Vireo, the apparently newly fledged bird remained in approximately the same place for more than 24 hours. The young cowbird is assumed to have hatched in a nest about 60 feet away where another Red-eyed Vireo was tending a single nestling of its own species. The afternoon of 1 July, Potter saw the vireo feed the cowbird several times. After the second feeding, the foster parent remained nearby, but it did not appear to be foraging even though the chick continued to beg insistently. Suddenly the vireo swooped past the cowbird's posterior and flew away with a white mass in its beak. The mass appeared to be fecal matter. Examination of the ground under the perch revealed no droppings even though the fledgling is believed to have remained in the same tree for the better part of 2 days. Later in the day the young cowbird began moving to different trees. By 6 July, presumably the sixth day after fledging, the cowbird was still being cared for by the vireo in the same part of the yard. Through 14 July Potter heard calls that seemed to be those of a young cowbird and saw vireos in the vicinity of the source of the sound, but the height of the trees and the density of the foliage made it impossible to determine whether the vireo was still feeding the cowbird. All sites were within 200 feet of the vireo nest.

The young cowbird does not become imprinted upon the foster parents (Pettingill 1970, p. 394). Soon after dependency it flocks with others of its own kind. How the fledgling makes the transition from associating with the host species to flocking with other cowbirds is not clearly understood. Apparently the adult female keeps an eye on the parasitized nest and watches over the fledgling. Bent (1958, p. 441-442) cites three examples of adult females feeding young, apparently but not certainly their own. Whitehurst (1977) describes what appears to be the female's manner of attracting the chick away from the foster parents. Although she has not witnessed a repetition of an adult female's calling to a fully fledged young cowbird that later flew away with her, Whitehurst has seen other adult cowbirds in her yard on numerous occasions when fledglings were still dependent on the foster parents. On 10 August 1976, Whitehurst saw a female cowbird and two immatures, previously fed by two towhees, sitting together in a tree. There seems to be no reason to doubt that female cowbirds play an active role in assembling immatures into flocks.

DISCUSSION

Between 1933 and the mid-1960s, the Brown-headed Cowbird became known as a brood parasite throughout the Carolinas. The earliest known breeding records came from the mountains, western piedmont, and northern coastal region. Later the species invaded the eastern piedmont, inner coastal plain, and southern coastal region. The population levels appear to have stabilized during the mid-1970s in many of the western counties, but an upward trend is still evident in the more recently invaded areas. Throughout the Carolinas, the cowbird population appears to be relatively sparse compared to the number of potential hosts, and reports indicating two or more cowbird eggs in one nest are uncommon. Although a continued increase in the cowbird breeding population seems inevitable, the species does not appear likely to undergo the dramatic population explosion we have seen in the range expansion of introduced species such as

the Starling and House Sparrow. Natural controls seem to be keeping the cowbird population within reasonable limits.

What effect has the Brown-headed Cowbird had on the populations of host species during nearly a half century of brood parasitism in the Carolinas? Several species—notably Bewick's Wren, Bachman's Sparrow, and Yellow Warbler—have declined, or at least contracted their range, during the past 50 years; however, there is no proof that cowbird parasitism is responsible for these changes. Indeed, the cowbird's most commonly reported host in the Carolinas is the Rufous-sided Towhee, which was not known to breed in Wake County in 1930 (Hader 1969). It has become a common nesting bird in the Raleigh area and remains so in spite of raising more than its share of young cowbirds. This absence of significant harmful effects on the host species (except one already scarce or endangered for other reasons) is consistent with the experience of other observers (Pettingill 1970, Southern and Southern 1980). The Brown-headed Cowbird is a remarkably adaptive species that seems to balance its own reproductive demands against the need to preserve the abundance of birds that make the most successful foster parents for young cowbirds.

Host selection and egg-laying behavior have been well studied in the Brown-headed Cowbird, but regional differences in the rates of parasitism for the nests of some common hosts raise interesting questions about host preferences. Much remains to be learned about the care of fledglings, especially the role of the adult female cowbird in watching over her offspring and in attracting them away from the foster parents. Careful observations may reveal that adult females and the young of the year have a far more complex relationship than is presently known or even suspected.

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