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UNSUITABILITY OF THE HOUSE FINCH AS A HOST OF THE BROWN-HEADED COWBIRD[1]

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Abstract. Brown-headed Cowbirds (*Molothrus ater*) parasitized 99 (24.4%) of 406 House Finch (*Carpodacus mexicanus*) nests observed at Barrie, Guelph, Orillia, and St. Catharines, Ontario, Canada, during the periods 1983–1985 and 1990–1993. Hatching success of cowbird eggs was 84.8%, but no cowbird was reared. Cowbird growth was severely retarded; nestlings required about twice as much time to accomplish the same amount of growth observed in nests of other hosts. Estimated final body mass of nestling cowbirds was about 22% lower than normal. Cowbird nestlings survived on average only 3.2 days. Only one cowbird fledged but died within one day. Lack of cowbird survival in nests of the House Finch appears to be the result of an inappropriate diet. We conclude that nestling diet may be important in determining cowbird choice of host.

Key words: Brown-headed Cowbird; Molothrus ater; *House Finch;* Carpodacus mexicanus; *brood parasitism; cowbird survivorship; nestling diet.*

INTRODUCTION

The Brown-headed Cowbird (*Molothrus ater*) is an obligate brood parasite that lays its eggs in the nests of many host species, which provide parental care (Friedmann and Kiff 1985). For parasitism to be successful, hosts must not only accept and incubate cowbird eggs, (Rothstein 1975) but they also must provide the nestling parasite with adequate nourishment for proper development. The food of cowbird hosts varies widely from animal to plant material (Martin et al. 1951), but almost all feed their young primarily animals. Some taxa, however, feed their nestlings plant material and failure of cowbird parasitism in the nests of these species is believed to be the result of inadequate diet (Eastzer et al. 1980, Middleton 1991).

The House Finch (*Carpodacus mexicanus*) is an occasional host of the Brown-headed Cowbird (Friedmann 1966, Friedmann et al. 1977). This finch feeds on a variety of plant materials, but most of the diet consists of weed seeds. The few animals taken are mainly aphids and caterpillars (Woods 1968). Like other members of the Carduelinae, House Finches are unusual among cowbird hosts in that they feed their young primarily plant material. The food is given to nestlings by regurgitation; it is neither partially digested nor does it contain nutritive secretions from the adult (Newton 1972). Similar diets fed to cowbirds by other species are insufficient, which implies that the House Finch, too, would be unable to rear the parasite. The purpose of the present study was to determine the frequency of successful parasitism on House Finch nesting, and hence the suitability of this species as a host of the Brown-headed Cowbird.

METHODS

Data were collected at sites in southern Ontario in the towns of Barrie, Guelph, Orillia, and St. Catharines, from May to August 1983–1985 and 1990–1993. House Finch nests were found by systematically searching through residential neighborhoods for singing territorial males or evidence of nest construction. Nests were commonly placed in ornamental conifers near dwellings and were positioned 0.9 to 6.0 m ($\bar{x} = 2.44$, SD = 0.729, $n = 373$) above ground. Most nests

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were easily reached using a six-foot (2 m) step-ladder. The contents of higher nests were observed with the aid of a small mirror positioned on the end of a telescopic pole. Parasitized nests contained cowbird eggs, cowbird nestlings or both. These nests were monitored daily at approximately the same time except in 1992 and 1993 when nests were visited twice per week. The fate of most cowbird nestlings was determined but data on their growth and survivorship were taken only from individuals that were observed daily from hatching (day 0). Cowbird nestlings in a nest were marked uniquely by toenail-clipping (St. Louis et al. 1989). Nestling body mass was measured using 10- and 50-g Pesola® spring scales accurate to 0.1 and 0.25 g, respectively. Wing chord and length of ninth primary (tip of feather to the point of emergence from the skin) were taken to the nearest 0.05 mm using dial calipers. Nestlings that disappeared were assumed to have died in the nest, the corpse having been removed by the foster parents (Welty and Baptista 1988). Predation of cowbirds was ruled out if the nest continued to hold House Finch eggs and/or young.

A nestling cardueline stores food temporarily in its distensible gullet before digestion (Newton 1972). In House Finch nestlings the full gullet appears as a large bulge on the right side of the neck, the contents of which can be easily observed through the thin, translucent skin. Initial observations of House Finch diet were made by external examination of the gullet. All young appeared to be receiving plant material mostly in the form of seeds. Finch and cowbird diets were studied more thoroughly by examination of nestling feces. At St. Catharines, fresh feces were collected from young during nest visits throughout the 1991 breeding season. Each sample was sealed in a separate vial and later stored at −20°C. Samples were taken when House Finches and cowbirds were 0–8 and 2–5 days old, respectively. One-hundred and thirteen fecal samples were collected from 67 House Finches at 23 nests and four samples were taken from two cowbirds at two nests. Upon examination, the samples were moistened with 70% ethanol, teased apart with dissecting needles, and the constituents identified under a binocular dissecting microscope. A drawback of using fecal samples for the analysis of diet is the fragmented nature of the food (Rosenberg and Cooper 1990). This is less of a concern with nestlings as their feces retain an undigested residue. Nonetheless, food became increasingly difficult to identify with age of nestlings because samples from older young contained relatively more digested food.

Growth coefficients were calculated for increase in body mass based on a logistic model of growth (Ricklefs 1984). The relative growth rate, K, asymptotic body mass, and time required to complete 10 to 90% of the asymptote, $t_{10\text{–}90}$, were determined using nonlinear least-squares regression (Gauss-Newton method, NLIN of SAS Institute 1985). Because sample sizes varied greatly among age groups of cowbirds, the data were weighted according to sample size. Thus, body mass values for each age group were accurately represented in the calculation of growth parameters. Cowbird growth data from Scott (1979) were similarly analyzed. The logistic model provided a suitable description of growth (r^2 approximation ≥ 0.8433).

RESULTS

The Brown-headed Cowbird parasitized 99 (24.4%) of 406 House Finch nests. Parasitized nests contained a total of 127 cowbird eggs. Of these, 79 survived through the incubation period and produced 67 (84.8%) nestlings. In addition, 11 cowbirds of varying age were discovered after they had hatched. No cowbird was successfully reared in a House Finch nest. Nestlings that perished in the nest were either found dead there (35.6%), or removed (64.4%) by the foster parents. Two discarded corpses were found on the ground near their respective nests. Only one cowbird fledged. It left the nest at age 14 d but was found dead the following day. Proportional survivorship of cowbird nestlings is shown in Figure 1. The average survival time was only 3.2 d (SD = 2.87, n = 25). Two birds did not survive beyond their day of hatching, whereas only one individual survived to 14 d.

Cowbird hatchlings had a mean body mass of 2.79 g (SD = 0.273, n = 23) and body mass increased in a largely linear fashion over the entire growth period (Fig. 2). Two nestlings failed to gain mass beyond two and five days of age and one individual lost mass after two days of age. The maximum nestling mass recorded was 22 g. Specific growth parameters for cowbirds reared by House Finches and other species are given in Table 1. Cowbird growth was severely retarded in House Finch nests. Cowbirds achieved

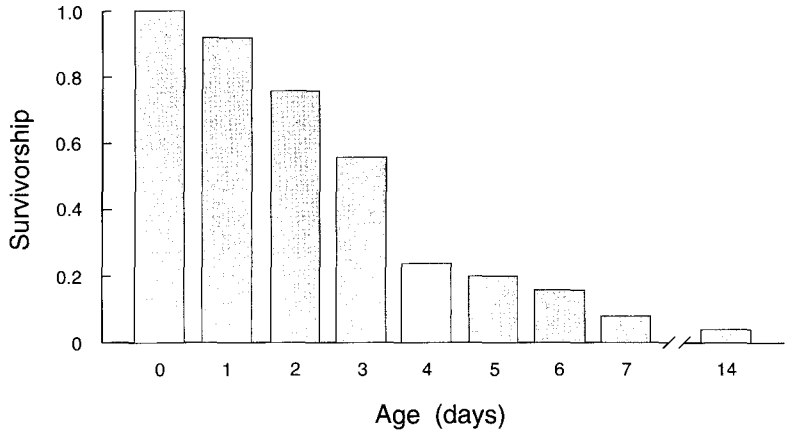

FIGURE 1. Proportional survivorship of Brown-headed Cowbirds (original $n = 25$) from hatching (0) to 14 d in nests of the House Finch.

an estimated asymptotic body mass that was 22.4% smaller than in nests of other hosts. The relatively smaller growth rate, K, approximately doubled the time required for growth.

Nestling cowbirds developed teleoptiles, but barbs did not emerge from the sheaths of most individuals. The single cowbird that fledged had well developed plumage when it left the nest. It showed substantial growth of barbs of all feather tracts and attained wing chord and ninth primary lengths of 63.00 mm and 33.15 mm, respectively.

House Finch diet consisted almost entirely of plant material including whole seeds, cotyledons (primary embryonic leaves) and the seed coats that cover them, plant fragments and pulp. Most seeds were small and ranged in length from 1 to 4 mm. Animals were identified in only eight (7.1%) samples and included eight mites (Acari), three springtails (Collembola) and three aphids (Aphididae). Grit first appeared in the meals of one-day-old House Finches. Samples of cowbird diet contained only plant material consisting mostly of whole seeds and seed parts and appeared to be largely undigested with very little indistinguishable plant material present.

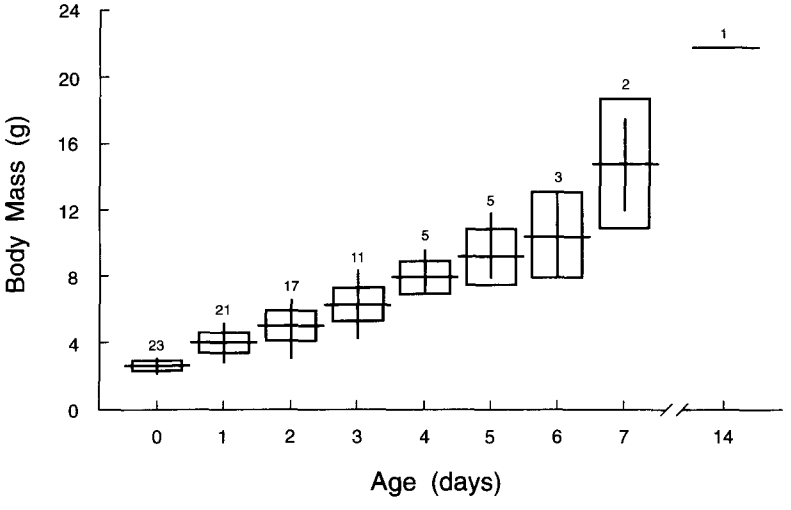

FIGURE 2. Increase of body mass of Brown-headed Cowbirds from hatching (0) to 14 d in nests of the House Finch. Horizontal bars indicate sample means, vertical bars the range, and the rectangles enclose ±1 standard deviation. Sample size is shown above plotted values.

TABLE 1. Specific growth parameters of nestling Brown-headed Cowbirds.

Host	*n*	Asymptote[a] (g)	Adult body mass[b] (g)	Ratio (*R*)	Growth rate[c] (*K*)	Growth rate[c] ($t_{10\text{-}90}$)	Source
Ovenbird, Wood Thrush	2	30.0	43.5	0.69	0.576	7.6	Ricklefs 1968[d]
Red-winged Blackbird, Song Sparrow, Yellow Warbler	8	28.8	43.5	0.66	0.597	7.4	Scott 1979
House Finch	23	22.8	43.5	0.52	0.318	13.8	present study

[a] Estimated final body mass of nestling growth.
[b] From Ricklefs (1968).
[c] Logistic growth rate constant, *K*, and time required to complete 10 to 90 percent of the asymptote, $t_{10\text{-}90}$.
[d] Data from Norris (1947).

DISCUSSION

Results indicate that the House Finch is an unsuitable host of the Brown-headed Cowbird. All attempts at parasitism failed with most cowbird nestlings perishing in the nest. There are no reports in the literature of cowbird nestlings in House Finch nests. Most of the existing records of parasitism mention the presence of cowbird eggs in House Finch nests (Friedmann 1963, Friedmann et al. 1977, Friedmann and Kiff 1985 and references therein), but provide no account of cowbird hatching success or nestling survivorship. Some data on cowbird nestling life in eastern North America are provided by the American Nest Records Card Program and in at least two cases corroborate the results of this study. Three records indicate cowbirds surviving from at least 2 to 10 d before predation of nest contents, or observations ended. Another nest contained one dead cowbird nestling of unknown age with two unhatched finch eggs. One observer reported the disappearance of a two-to-six day-old cowbird from a nest that also held two finch nestlings that later fledged successfully. The disappearance of cowbird nestlings is implied in four other instances, including one record from Oregon. Presumably, cowbird nestlings that disappeared from these nests had perished there and their bodies were removed by the foster parents. Given these findings, the probability of survival of cowbirds in House Finch nests appears to be exceedingly small.

Despite this high level of mortality, cowbird nestlings occasionally fledge from House Finch nests. In the present study, only one cowbird survived to leave its nest but either died of malnutrition (see below) or received no foster-parental care thereafter. Wauer (1964) reported an exception observed in California in which a fledgling cowbird (*M. a. obscurus*) was seen being fed by a House Finch. The rearing of cowbirds by this host appears to be very rare.

The type of diet that parents feed to their offspring is important in determining host suitability. Most passerines feed their young with arthropods and nestling diets show considerable overlap among sympatric species (Orians and Horn 1969, Maher 1979). Thus, there appears to be little restriction among hosts concerning the food of nestlings; a variety of species appear to provide equally adequate diets to cowbird young (see Norris 1947, Scott 1979). However, cowbirds fail to survive in nests of hosts that feed their nestlings regurgitated seeds, fruit or other plant material. Hatchling Brown-headed Cowbirds died, most within six days, after being placed in nests of the House Sparrow (*Passer domesticus*, Eastzer et al. 1980), which may feed their nestlings large quantities of plant material (Bent 1958). Cowbirds survived an average of only two days in American Goldfinch (*Carduelis tristis*) nests. Most cowbirds died by the fourth day and only one survived 12 days (Middleton 1991). Cowbirds may fledge from Cedar Waxwing (*Bombycilla cedrorum*) nests but occasionally die after three days when parents start to feed their young fruit rather than insects (Rothstein 1976). House Finches gave cowbird nestlings a specific diet consisting mainly of seeds. The failure of cowbirds to thrive on this food is additional evidence that this species is unlikely to survive on the special nestling diets of some granivorous or frugivorous species.

Most altricial young grow rapidly (Ricklefs 1968), which requires a protein-rich diet (O'Connor 1984). Food low in protein content may arrest growth severely (Johnson 1971, Roudybush and Grau 1986, Boag 1987). The poor development of cowbirds witnessed in House Finch

nests appears to be the result of protein deficiency. Nestling body mass did not follow a sigmoidal pattern typical of normal growth (Ricklefs 1968) and never attained the asymptotic level or fledging mass of cowbirds reared by suitable hosts. The body mass of two cowbirds did not increase, whereas another individual experienced weight recession. Feather growth was delayed and required additional time (about four days for the only individual that fledged) to achieve sizes observed for cowbirds ten days old (Scott 1979). Unlike suitable hosts, House Finches feed their young a diet that is limited in protein. Seeds and particularly fruits are generally low in protein (Newton 1972:179, Morton 1973, O'Connor 1984, Johnson et al. 1985). Furthermore, plant proteins often lack one or several of the essential amino acids that cannot be synthesized by the animal itself (Needham 1964, Parrish and Martin 1977, Sedinger 1990). Cowbirds in finch nests received a minuscule quantity of animal food, probably inadvertently consumed by foraging parents, that was grossly insufficient to meet their protein requirements.

The failure of cowbird parasitism on House Finch nesting may lend insight in the evaluation of host suitability by cowbirds. Because there is no reproductive success in parasitism of House Finches, they should be avoided by cowbirds. The frequency of parasitism observed in this study was relatively high; however, this may be a result of the recent association of this host and parasite in Ontario (Kozlovic 1994). Therefore, cowbirds may be under strong selection against choosing House Finches as hosts after the two species come into contact. Indeed, parasitism rate has decreased markedly with time of association between this host and parasite in eastern North America (Kozlovic, in prep.).

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LITERATURE CITED

BENT, A. C. 1958. Life histories of North American blackbirds, orioles, tanagers, and allies. U.S. Nat. Mus. Bull. 211.

BOAG, P. T. 1987. Effects of nestling diet on growth and adult size of Zebra Finches (*Poephila guttata*). Auk 104:155–166.

EASTZER, D., P. R. CHU, AND A. P. KING. 1980. The young cowbird: average or optimal nestling? Condor 82:417–425.

FRIEDMANN, H. 1963. Host relations of the parasitic cowbirds. U.S. Nat. Mus. Bull. 233:1–276.

FRIEDMANN, H. 1966. Additional data on the host relations of the parasitic cowbirds. Smithsonian Misc. Coll. 149:1–12.

FRIEDMANN, H., AND L. F. KIFF. 1985. The parasitic cowbirds and their hosts. Proc. West. Found. Vert. Zool. 2:225–304.

FRIEDMANN, H., L. F. KIFF, AND S. I. ROTHSTEIN. 1977.A further contribution to knowledge of the host relations of the parasitic cowbirds. Smithsonian Contr. Zool. 235:1–75.

JOHNSON, N. F. 1971. Effects of levels of dietary protein on Wood Duck growth. J. Wildl. Manage. 35: 798–802.

JOHNSON, R. A., M. F. WILLSON, J. N. THOMPSON, AND R. I. BERTIN. 1985. Nutritional values of wild fruits and consumption by migrant frugivorous birds. Ecology 66:819–827.

KOZLOVIC, D. R. 1994. The House Finch in Ontario, p. 298–306. *In* M. K. McNicholl and J. L. Cranmer-Byng [eds.], Ornithology in Ontario. Spec. Publ. No. 1, Ontario Field Ornithologists. Hawk Owl Publ., Whitby, Ontario.

MAHER, W. J. 1979. Nestling diets of prairie passerine birds at Matador, Saskatchewan, Canada. Ibis 121: 437–452.

MARTIN, A. C., H. S. ZIM, AND A. L. NELSON. 1951. American wildlife and plants, a guide to wildlife food habits. McGraw-Hill, New York.

MIDDLETON, A. L. A. 1991. Failure of Brown-headed Cowbird parasitism in nests of the American Goldfinch. J. Field Ornithol. 62:200–203.

MORTON, E. S. 1973. On the evolutionary advantages and disadvantages of fruit eating in tropical birds. Am. Nat. 107:8–22.

NEEDHAM, A. E. 1964. The growth process in animals. Pitman and Sons Ltd., London.

NEWTON, I. 1972. Finches. William Collins Sons and Co. Ltd., Glasgow.

NORRIS, R. T. 1947. The cowbirds of Preston Frith. Wilson Bull. 59:83–103.

O'CONNOR, R. J. 1984. The growth and development of birds. John Wiley and Sons Ltd., Chichester.

ORIANS, G. H., AND H. S. HORN. 1969. Overlap in foods and foraging of four species of blackbirds in the potholes of central Washington. Ecology 50: 930–938.

PARRISH, J. W., JR., AND E. W. MARTIN. 1977. The effect of dietary lysine level on the energy and nitrogen balance of the Dark-eyed Junco. Condor 79:24–30.

RICKLEFS, R. E. 1968. Patterns of growth in birds. Ibis 110:419–451.

RICKLEFS, R. E. 1984. Components of variance in measurements of nestling European Starlings (*Sturnus vulgaris*) in southeastern Pennsylvania. Auk 101:319–333.

ROSENBERG, K. V., AND R. J. COOPER. 1990. Approaches to avian diet analysis. Stud. Avian Biol. 13:80–90.

ROTHSTEIN, S. I. 1975. An experimental and teleonomic investigation of avian brood parasitism. Condor 77:250–271.

ROTHSTEIN, S. I. 1976. Cowbird parasitism of the Cedar Waxwing and its evolutionary implications. Auk 93:498–509.

ROUDYBUSH, T. E., AND C. R. GRAU. 1986. Food and water interrelations and the protein requirement for growth of an altricial bird, the Cockatiel (*Nymphicus hollandicus*). J. Nutr. 116:552–559.

SAS INSTITUTE. 1985. SAS/STAT users guide. Cary, NC.

ST. LOUIS, V. L., J. C. BARLOW, AND J-P. R. A. SWEERTS. 1989. Toenail-clipping: a simple technique for marking individual nidicolous chicks. J. Field Ornithol. 60:211–215.

SCOTT, T. W. 1979. Growth and age determination of nestling Brown-headed Cowbirds. Wilson Bull. 91:464–466.

SEDINGER, J. S. 1990. Are plant secondary compounds responsible for negative apparent metabolizability of fruits by passerine birds? A comment on Izhaki and Safriel. Oikos 57:138–140.

WAUER, R. H. 1964. Ecological distribution of the birds of the Panamint Mountains, California. Condor 66:287–301.

WELTY, J. C., AND L. F. BAPTISTA. 1988. The life of birds. Saunders, New York.

WOODS, R. S. 1968. *Carpodacus mexicanus frontalis* (Say), House Finch, p. 290–314. *In* A. C. Bent (O. L. Austin, Jr. [ed.]), Life histories of North American cardinals, grosbeaks, buntings, towhees, finches, sparrows, and allies. U.S. Nat. Mus. Bull. 237.