

1982). In particular, the female benefits by feeding herself and her brood with cached food at the time of her choice, rather than being directly fed by the male. By providing food for the female at cache sites near the nest during the brooding period, the male probably reduces the time the nest is exposed and increases the time he spends near the nest feeding and is available for nest defense. The auxiliary I observed usually was barred from access to food caches.

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**Clutch size increase and intraspecific brood parasitism in the Yellow-billed Cuckoo.**—Two recent reports have documented an increased clutch-size in new world cuckoos (*Coccyzus*) as a probable response to a superabundant food resource (periodical cicadas in the Yellow-billed Cuckoo [*C. americanus*] Nolan and Thompson, *Ibis* 117:496–503, 1975; tent caterpillars in the Black-billed Cuckoo [*C. erythrophthalmus*], Sealy, *Condor* 80:103–104, 1978). Additionally, Nolan and Thompson (1975) provided evidence of interspecific brood parasitism and other laying anomalies during these periods of abundant food. Previous observations suggest that behavior such as intra- and interspecific brood parasitism (Darwin, *The Origin of Species*, 6th ed., John Murray, London, England, 1872; Bent, *Bull. U.S. Natl. Mus.* 176:1–506, 1940; Nolan and Thompson 1975), varying clutch and egg-size (Bent 1940, Nolan and Thompson 1975), and asynchronous hatching and interrupted schedules of laying (Bent 1940; Hamilton and Hamilton, *Proc. Cal. Acad. Sci.* 32:405–432, 1965) are regular aspects of *Coccyzus* breeding biology. As these normally non-parasitic cuckoos are related to obligate brood parasitic species, such observations may provide important clues as to the factors responsible for the evolution of brood parasitism (Hamilton and Orians, *Condor* 67:361–382, 1967; Payne, *Ann. Rev. Ecol. Syst.* 8:1–28, 1977).

Intraspecific brood parasitism may be documented by eggs appearing after a clutch appears to be complete (Nolan and Thompson 1975) by eggs within a clutch differing greatly in size, shape or coloration (Todd, *Birds of Western Pennsylvania*, Univ. Pittsburgh Press, Pittsburgh, Pennsylvania, 1940; Hamilton and Hamilton 1965; Nolan and Thompson 1975), or by examining egg proteins with electrophoresis (Manwell and Baker, *Aust. J. Biol. Sci.* 28:545–557, 1975). Given cuckoos' unusual breeding habits, this latter method would seem to be the most reliable. Because proteins of undeveloped eggs are those of the mother alone, any protein polymorphism reflects (with high probability) the maternal genotype. If, therefore, different genotypes occur between eggs within a single nest it is very likely that two or more females contributed eggs to that nest (Manwell and Baker 1975; Yom-Tov, *Biol. Rev.* 55:93–108, 1980).

In this note we present observations made on the nesting of the Yellow-billed Cuckoo in eastern Kansas during spring and summer of 1981. The spring of 1981 was an emergence period for the 17-year periodical cicada (*Magicicada* spp., Brood XIV), and had abnormally high numbers of other insects (R. Holt, pers. comm.). Because of the prior report correlating cicada years with breeding anomalies in cuckoos, we attempted to determine whether 1981 clutch sizes were larger than those of previous non-cicada years, and whether intraspecific brood parasitism was occurring.

*Methods.*—We searched for nests in and around Lawrence, Douglas Co., Kansas, during the period 1 May–15 August 1981. After locating a nest, we revisited it if possible and recorded the order and dates of laying, the final clutch-size, and the fate of the nest. To

TABLE 1  
ELECTROMORPH AT THE ESTERASE LOCUS, LENGTH, WIDTH, AND LENGTH/WIDTH FOR EACH  
EGG OF NEST A OF THE YELLOW-BILLED CUCKOO FROM DOUGLAS COUNTY, KANSAS

Egg #	Esterase electromorph	Length (mm)	Width (mm)	Length/width
1 <sup>a</sup>	ss	28.5	24.6	1.16
2	ss	29.1	24.7	1.18
5	ss	29.5	24.9	1.19
3	ff	32.0	22.2	1.44
4	ff	33.2	23.1	1.44

<sup>a</sup> Egg numbers given arbitrarily.

compare clutch-sizes for 1981 to those of other years in the same general locality, we used nest-data card records from files in the Ornithology Division, Museum of Natural History, University of Kansas. We used only local nests where the observer noted that the clutch was complete, or the nest was followed by the observer past hatching. We also included seven clutches from a 1972 study in the same area (P. von Achen, pers. comm.; Fitch and von Achen, *Kans. Ornithol. Soc. Bull.* 24:12-15, 1973). If interrupted laying (Hamilton and Hamilton 1965) was overlooked, these data would be biased towards lower clutch-size. We have no reason, though, to believe that this was the case. We had no records from other years of periodical cicada emergence.

We collected two, five-egg clutches for electrophoresis. Egg white was removed from each egg and the relative amount of embryonic development was noted. We resolved esterases and general proteins on starch gels using a LiOH-borate buffer of pH 6.7 (Selander et al., *Univ. Texas Publ.* 7103:49-90, 1971). Egg length and width were measured, and a ratio of length to width was computed.

*Results.*—We found 10 nests between 1 June and 15 August 1981. Seven of these were found in June. Periodical cicadas emerged in early May, peaked in late May, and most were gone by mid-June. Thus, all of the cuckoo clutches were initiated after the peak of cicada abundance. Of six cuckoo nests that were followed to their end, five were depredated and one was blown from its tree. Mean clutch-size ( $3.80 \pm 0.92$  eggs,  $N = 10$ ) was significantly larger than the mean clutch-size of 55 nest records ( $3.19 \pm 0.87$ ,  $t = 2.02$ ,  $P \leq 0.05$ ). Clutch-size was independent of date ( $r = 0.05$ ,  $P > 0.95$ ).

Both of the five-egg clutches had eggs in various stages of development. Clutch A had three eggs with small but various-sized embryos (eggs 1, 2, and 4; eggs were numbered arbitrarily), and two with relatively little development (eggs 3 and 5). Clutch B also had various stages of development. Yellow-billed Cuckoos generally begin incubation after laying their first egg. Thus, asynchronous development might be expected. We found no apparent electrophoretic differences between egg white from the developed and undeveloped eggs.

No polymorphism was detected on gels stained for general proteins. On gels stained for esterase, three presumptive loci were resolved. In clutch B no differences in electromorphs were evident. However, within clutch A locus 1 exhibited two morphs (designated here as putative genotypes ff and ss). Eggs 1, 2, and 5 were ss, eggs 3 and 4 were ff (Table 1). Considering that eggs 3 and 5 were undeveloped and that egg white proteins are of maternal origin (Manwell and Baker 1975), it is probable that eggs 1, 2, and 5 were from a female(s) different from the one which laid eggs 3 and 4. Even if these are embryonic genotypes, the

probability is very low ( $\chi^2 = 5.4$ ,  $df = 2$ ,  $P = 0.07$ ) that a heterozygote cross, segregating under Mendelian laws, would result in these genotype frequencies.

The electrophoretic results, by themselves, cannot tell us whether more than two females laid the eggs, only that at least two females laid the eggs. However, the length and width of eggs 1, 2, and 5 were very different from those of eggs 3 and 4 (Table 1). Shape of the eggs, as the ratio of length to width, appears to be a stronger discriminator than average dimensions (Table 1). These results, combined with the electrophoretic results, suggest that a single female laid eggs 1, 2, and 5, and that a different, single female laid eggs 3 and 4.

*Discussion.*—Our data suggest a positive reproductive response to a periodical cicada eruption (as in Nolan and Thompson 1975). This suggests that when a female cuckoo obtains excess food she can increase her clutch-size. For cuckoos, which sometimes have difficulty finding their uncommon food (Bent 1940, Hamilton and Hamilton 1965), such plasticity may be of considerable adaptive value.

Nolan and Thompson (1975) found that nesting anomalies occur with greater frequency during years when extra food resources are available. While we have no data with which to compare years, the anomalies reported here did occur during the period of cicada emergence. Cuckoos have long been supposed to be intraspecifically brood parasitic (Bent 1940, Hamilton and Hamilton 1965, Nolan and Thompson 1975); above we presented evidence which supports this view. Manwell and Baker (1975) and Gowaty and Karlin (Behav. Ecol. Sociobiol. 15:91–95, 1984) also used electrophoretic data to detect intraspecific brood parasitism in House Sparrows (*Passer domesticus*) (where nearly 10% of the clutches examined were of mixed motherhood) and in Eastern Bluebirds (*Sialia sialis*), respectively. From our limited sample of clutches we cannot assess the frequency of such parasitism, or its impact on the host or parasite's reproductive success.

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**Bathing behavior of Purple Martins.**—A description of Purple Martin (*Progne subis*) bathing behavior is given in Bent (Life Histories of North American Flycatchers, Larks, Swallows, and Their Allies, Dover, New York, New York, 1963:429) from observations made by Audubon: "They are very expert at bathing and drinking while on the wing, when over a large lake or river, giving a sudden motion to the hind part of the body, as it comes into contact with the water, thus dipping themselves in it, and then rising and shaking their body like a water spaniel, to throw off the water."

In August 1980 I observed bathing behavior of Purple Martins near a roost in Ann Arbor, Washtenaw Co., Michigan. Martins arriving in the area prior to entering the roost perched on utility wires 150–200 m away from the site. Martins bathed in a waste water lagoon (ca 0.6 ha) 20–50 m from the utility wires. Martins that were engaged in bathing activity flew from the wires to a height of 2–6 m above the water surface and circled for 30 sec to 3 min before making first contact with the water. After bathing, the birds flew back to the wires