SEX RATIO OF NESTLINGS AND CLUTCH SIZE IN THE BOAT-TAILED GRACKLE

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In most species of birds so far studied, the sex ratio among nestlings is nearly equal (Mayr, 1939; Lack, 1954:10; Hickey, 1955:347–348), but very unequal ratios have been reported for two species of icterids in Louisiana by McIlhenny (1937*a* and 1940). For the Boat-tailed Grackle (*Cassidix mexicanus*), McIlhenny claims a nestling ratio of 30 per cent males to 70 per cent females; and, for the Redwinged Blackbird (*Agelaius phoeniceus*), a nestling ratio of 77 per cent males and 23 per cent females is reported. These proportions are similar to those of adult and first-year birds of these species recorded by McIlhenny in his extensive trapping and banding operations in Louisiana.

Unbalanced sex ratios in adult vertebrate populations (tertiary ratios; see Mayr, 1939:157) are not unusual. In all species of birds for which adequate data are available, unbalanced tertiary ratios have been found to result from differential mortality in the two sexes beyond the nestling stage (Lack, 1954:108–113). It is, therefore, understandable that reports of any considerable deviation from the expected 50:50 ratio at fertilization (primary ratio), at hatching (secondary ratio), or among nestlings present problems of interest to population ecologists and geneticists alike. For this reason, it seemed desirable to re-examine the sex ratio in nestling Boat-tailed Grackles. In reporting an equal sex ratio among nestling Redwinged Blackbirds in Ohio, Williams (1940) has already cast doubt on the validity of McIlhenny's findings for that species. Anticipating the major conclusion of the present study, it may be stated that there is no indication of an unbalanced sex ratio among nestling Boat-tailed Grackles in Texas.

Data on clutch size, asynchrony of hatching, and egg and nestling mortality, obtained in the course of the study of sex ratios, have been included in this report; other aspects of the breeding biology and behavior of the Boat-tailed Grackle will be considered elsewhere.

ACKNOWLEDGMENTS

This research was supported by a National Science Foundation Research grant (G–7121). I am indebted to Mr. Donald R. Giller and Mr. James D. Spears for assistance at the nesting colony. This paper has had the benefit of critical reading by Dr. Richard F. Johnston.

METHODS AND MATERIALS

All data herein reported were obtained from a single breeding colony in a giant live oak tree (*Quercus virginiana*) located along the Austin-Bastrop highway near the settlement of Montopolis, at the eastern limit of the city of Austin, Travis County, Texas (fig. 1). The tree held a total of 128 nests on April 29, 1959, most of which were placed 30 or more feet above the ground. On April 29, 18 nests were removed from the tree, and an additional 100 nests were examined and/or removed a week later, on May 6. If eggs were present, the number was recorded and, in most cases, one or more was broken to determine the degree of incubation. All nestlings were removed, dissected to determine the sex, and preserved, with gonads intact, for further study. In several cases where eggs were pipped, the young were removed from the eggs and the sex determined by dissection. All sex determinations were based on examination of gonads.

SEX RATIO OF NESTLINGS

The contents of 118 nests from the Montopolis colony are shown in table 1. It is evident that there is little synchrony in the breeding activities of the females; this is

typical of breeding colonies in the Austin region, but McIlhenny (1937*a*) reported close synchrony in colonies in marshes at Avery Island, Louisiana.

Thirty-nine nests contained young. The age of nestlings varied from a few hours to an estimated 17 days; weights ranged from 4.4 to 111 grams. The first young had fledged from this colony on April 23.

A total of 83 nestlings from 39 nests was sexed (table 2). The results: 47 males and 36 females. The observed deviation from an expected 50:50 ratio is not significant

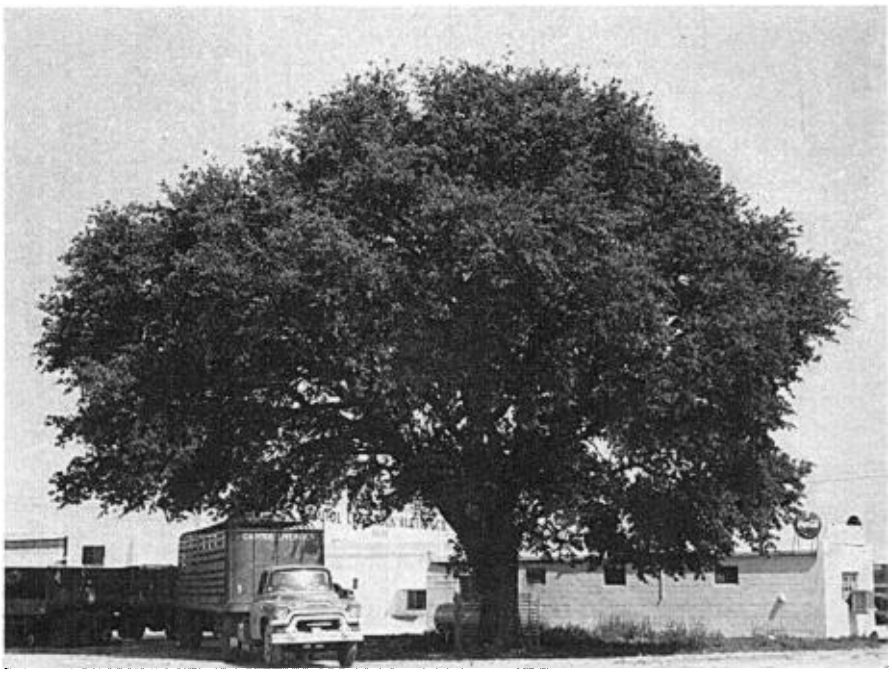

Fig. 1. Live oak near Montopolis, Travis County, Texas, used for nesting by a large colony of Boat-tailed Grackles; several males may be seen perched at the top of the tree.

(Chi-square=1.46, P=0.30). Considering only those nests in which three or four nestlings were present, an approximate primary ratio can be calculated, as shown in table 3. Males predominate in the sample, but the deviation is of doubtful significance (Chi-square=3.90, P=0.05). Thus, the data from the Montopolis colony provide no evidence of unbalanced primary or nestling sex ratios.

McIlhenny (1940:88–89) presented data on sex of young Boat-tailed Grackles from "137 nests in which the full complement of three young matured, as recorded in the five-year period 1935 through 1939, both inclusive." Assuming, as McIlhenny has claimed, that each set of three represents a full clutch (see beyond), these data yield a primary sex ratio of 1 male to 2.51 females (table 3). The sex ratio of nestlings from broods of various sizes, calculated from data from 89 nests examined by McIlhenny (1937*a*) in 1936, is similar to the primary ratio.

Although McIlhenny's data pertain to *C. m. major* and those of the present study to *C. m. prosopidicola*, I am unwilling to believe that the discrepancy in our findings can be accounted for on the basis of geographic variation in sex ratios. McIlhenny's determinations are questionable. He does not clearly state his method of sexing the nestlings,

but from his remarks it is clear that he did not examine gonads. With reference to the Boat-tailed Grackle and Redwinged Blackbird, he notes (1940:85) that, "In both of these species it is easy to distinguish the sex *by sight,* five or six days after hatching [italics mine]." And, referring to the Redwinged Blackbird, he states (*in* Williams, 1940:268): "The sex of the Gulf Coast Red-wing [*A. p. littoralis*] nestlings can be told

Table 1

Contents of 118 Nests of the Boat-tailed Grackle from the Montopolis Colony

Contents	April 29	May 6	Total
Nest in construction	1	1	2
Nest empty	2	22	24
1 egg	1	7	8
2 eggs	5	10	15
3 eggs	3	13	16
4 eggs	2	11	13
5 eggs	0	1	1
Small nestlings[1]	1	15	16
Large nestlings[2]	3	18	21
Young ready to fledge	0	2	2
Totals	18	100	118

[1] Largest nestling in brood under 40 gm.
[2] Largest nestling in brood over 40 gm.

Table 2

Sex Ratio in 39 Nests of the Boat-tailed Grackle from the Montopolis Colony

Nest ratio (males to females)	Frequency	Males	Females
1 to 0	2	2	0
2 to 0	4	8	0
3 to 0	3	9	0
3 to 1	1	3	1
2 to 1	3	6	3
2 to 2	2	4	4
1 to 1	13	13	13
1 to 2	0	0	0
1 to 3	1	1	3
0 to 3	0	0	0
0 to 2	3	0	6
0 to 1	5	0	5
1 to sex?	1	1	0
sex? to 1	1	0	1
Total	39	47	36

with certainty at any time after the fifth day from external appearances of the bill, torso, and general body size."

Since McIlhenny reported (1937*a*:275) that the juvenal plumages of male and female *C. m. major* are identical, we may presume that his sex determinations of nestling grackles were based on size differences. At least in *C. m. prosopidicola,* there is no sexual dimorphism in nestlings with regard to color or markings of the bill or other soft

parts. Moreover, the fact that McIlhenny does not indicate that he marked individual nestlings at hatching leads one to suspect that his determinations of sex in both grackles and Redwinged Blackbirds were made by comparing relative sizes of individuals in a nest. In a careful study of development of nestling Redwinged Blackbirds in Ohio, Williams (1940) has shown that the range of individual variation in size is sufficiently great that an error of one day in ageing might involve an error in sexing even after the eighth day from hatching. Likewise in the Boat-tailed Grackle, I doubt that sex determination of nestlings could be made on the basis of size before about eight days of age, even if the ages of the nestlings were accurately known. The fact that hatching tends to be asynchronous (see beyond) complicates the problem of sexing nestlings on the basis of size.

Table 3

Summary of Data on Sex Ratios Among Nestling Icterids

Region	Ratio	Number of nests	Number of nestlings	Male	Female	Percentages Male	Percentages Female
BOAT-TAILED GRACKLE							
Texas	Primary	9	31	21	10	67.7	32.3
	Nestling	39	83	47	36	56.6	43.4
Louisiana	Primary[1]	137	412	125	287	30.3	69.7
	Nestling[2]	89	205	70	135	34.1	65.9
REDWINGED BLACKBIRD							
Ohio	Primary[3]	35	119	57	62	47.9	52.1
Louisiana	Primary[2]	140	420	322	98	76.7	23.3

[1] McIlhenny (1940)
[2] McIlhenny (1937*a*)
[3] Williams (1940)

As noted previously, Williams (1940) was unable to confirm McIlhenny's claim of a strongly unbalanced sex ratio in nestling Redwinged Blackbirds. Data from the two studies are summarized in table 3; McIlhenny worked with *A. p. littoralis*, and Williams with *A. p. phoeniceus*. Unlike McIlhenny, Williams marked nestlings soon after they hatched and was able to determine ranges of variation in weight and tarsal length in the two sexes at different ages. His sex determinations based on size were checked in many cases by examination of gonads.

Herman (1938) has also claimed a preponderance of males among nestling Redwinged Blackbirds, but his ratio was derived from birds which were banded as nestlings but not sexed until they were trapped sometime after leaving the nest. Williams (1940: 275) has already pointed out the several sources of error in this method.

Using relative size as the criterion of sex, Fautin (1941*b*:217) estimated the sex ratio of nestling Yellow-headed Blackbirds (*Xanthocephalus xanthocephalus*) in Utah as 51 per cent females to 49 per cent males in one colony and 55 per cent females to 45 per cent males in another.

Tertiary sex ratios in icterids.—The interesting relationship between tertiary sex ratios and mating relationships in the Icteridae has been discussed by Mayr (1939:172) and Williams (1952:34–35). There is no evidence of a preponderance of one sex in non-colonial, monogamous species, but for several species which nest colonially or are parasitic, most if not all of which are polygamous or promiscuous, there are reports of markedly unbalanced sex ratios at breeding colonies or at banding stations.

A greater number of females than males has been reported in *Cassidix mexicanus* (33.1 per cent males among 5333 birds trapped in Louisiana, McIlhenny, 1940:88; and 2 or 3 females to 1 male at breeding colonies in Guatemala, Skutch, 1954:326); *Euphagus cyanocephalus* (ratios in breeding populations in California varied from 13 males and 14 females in 1943 to 18 males and 36 females in 1947, Williams, 1952:16); *Xanthocephalus xanthocephalus* (35 males to 83 females and 12 males to 40 females in two breeding colonies in Utah, Fautin, 1940:78; about 2 females per male at breeding colonies in Nevada, Linsdale, 1938:127–135); *Zarhynchus wagleri* (6 or 7 males and 39 females at a breeding colony in 1926, and 5 or 6 males and 29 females at the same colony in 1927, in Panamá, Chapman, 1928:135); *Gymnostinops montezuma* (females outnumbered males "several to one" at breeding colonies in Central America, Skutch, 1954: 294); *Cacicus cela* (a colony of 15 females and at least 8 males in Panamá, Skutch, 1954:308); and *Psomocolax oryzivorus* (females "always outnumbered the males by several to one," in Guatemala, Skutch, 1954:318). A surplus of males has been reported in the parasitic cowbirds, *Molothrus ater* (1902 males to 769 females trapped in Louisiana, McIlhenny, 1937*b*; "about three males to two females," Friedmann, 1929:173; see also Laskey, 1950); *Molothrus bonariensis* ("3 males to every 2 females," Friedmann, 1929:77); and *Tangavius aeneus* (Friedmann, 1929:326; but 1 male to 4 or 5 females in the breeding season in El Salvador, Dickey and van Rossem, 1938:540). In *Agelaius phoeniceus*, females outnumber males at the breeding colonies (Nero, 1956*a*:6), but McIlhenny (1940) reports 84.4 per cent males among 6480 birds trapped in Louisiana. In breeding colonies of *Agelaius tricolor*, Lack and Emlen (1939:229) found about 47 males to each 100 females.

Although there is reason to believe that some icterids have unbalanced tertiary sex ratios, it is doubtful that the actual proportions of the sexes in populations of any one species are accurately reflected in the information presently available. Mayr (1939: 157–159) has already noted some sources of error in determination of tertiary ratios in birds which are migratory or which show marked sexual dimorphism. To his discussion, it may be added that ratios based on counts of birds present at breeding colonies are especially subject to error in that first-year birds of one sex may be absent. For example, first-year male Boat-tailed Grackles do not hold territories at the breeding colonies and, with rare exception, do not breed, whereas first-year females normally breed. In the first half of the breeding season, first-year males rarely even visit the breeding colonies, although some may be present later in the season. Therefore, the fact that males are outnumbered 2 or 3 to 1 by females at breeding colonies in the Austin region, as they are also in Guatemala (Skutch, 1954:326), does not mean that the tertiary ratio is unbalanced to the same degree. In the Austin region, females probably outnumber males, but the actual ratio has not been determined.

First-year male Redwinged Blackbirds normally do not establish territories or breed, although they may visit the colonies (Nero, 1956*b*:141; Wright and Wright, 1944). Lack and Emlen (1939:229) note that at least some male Tricolored Blackbirds do not breed in the first year; and Fautin (1941*a*:117) found no first-year males at breeding colonies of the Yellow-headed Blackbird. It would not be surprising to find that first-year males of some other icterids, especially the large orpendolas, do not breed. Possibly the greater number of females than males in breeding populations may be due in large part to differing times of sexual maturity in the sexes, as suggested by Williams (1952: 35), Lack and Emlen (1939:229), Linsdale (1938:135), and others, rather than to an actual marked imbalance in the sex ratio. That nonbreeding of first-year males is not the only factor involved is indicated, however, by Williams' study (*loc. cit.*) of the Brewer Blackbird.

Trapping records may be no more reliable in determining tertiary ratios, for there are several sources of error in this method. In the nonbreeding season, flocks may be composed predominantly of one sex, and such flocks may differ not only in migrational pattern but in use of foraging and roosting localities within one area. Also, one sex may be more prone to enter a particular type of trap. In the Austin region, female Boat-tailed Grackles enter small box traps less readily than do males; and flocks of males frequently visit parks and other open areas in the city, whereas female flocks generally confine their activities to agricultural fields outside of town. McIlhenny (1940:89–90) also noted that the sex ratio of Boat-tailed Grackles trapped on a given day in Louisiana depended on whether a male or female live "decoy" was used to attract the birds to the trap.

CLUTCH SIZE

At the Montopolis colony, a total of 53 nests contained eggs but no nestlings (table 4). Eight nests contained one egg only; six of these eggs were fresh, one was decayed, and the condition of one was not determined. It may be assumed that a single egg never constitutes a complete clutch. In a total of 15 nests containing two eggs each, 10 sets were fresh, one set was well incubated, and the condition of four sets was not determined.

Table 4

Stage of Development of Eggs from the Montopolis Colony (April 29 and May 6)

Number of eggs in set	Number of sets	Fresh	Incubated	Addled	Undetermined
1	8	6	0	1	1
2	15	10	1	0	4
3	16	2	12	0	2
4	13	2	8	0	3
5	1	1	0	0	0
Total	53	21	21	1	10

From these data, I am inclined to infer that a set of two eggs may occasionally constitute a full clutch; and the well incubated set of two eggs has been considered in calculating clutch size, which is otherwise based on sets of three, four, and five eggs. Average clutch size in *C. m. prosopidicola* in the Austin region, based on 31 clutches, is 3.45±0.11 (σ=0.62). Clutches of three are most frequent, but those of four occur with almost equal frequency; clutches of two and five are unusual. These data pertain to first clutches of the season. Bent (1958:354) gives a range of clutch size of three to five for *C. m. prosopidicola* but does not present the data on which these figures are based.

Clutch size in the Boat-tailed Grackle varies geographically. Examining 49 nests of *C. m. mexicanus* at "Alsacia," Guatemala, Skutch (1954:342) found one with four eggs, 33 with three eggs, and 15 with two eggs. Average clutch size is 2.71±0.07 (σ=0.50) but, as the degree of incubation was not determined, there is some doubt as to how many of these sets represented completed clutches. According to McIlhenny (1937*a*: 282), in *C. m. major* at Avery Island, Louisiana, "the complement of eggs is invariably three," yet he mentions having seen one clutch of four! It is difficult to believe that there is so little variation in clutch size in *C. m. major*. Sprunt (1958:367) states that clutch size in *C. m. torreyi* varies from three to five, and he mentions finding "four on scores of occasions on the South Carolina coast and sometimes five. The latter number is unusual, the former all but the rule." Burleigh (1958:593) reports a set of four fresh eggs of

C. m. torreyi at Tybee Island, Georgia, where, however, the usual clutch size is said to be three (p. 595).

Asynchronous hatching.—Lack (1947:324–325; 1954:40–41) has proposed that asynchronous hatching and consequent inequality in size of the young in the nestling stage is an adaptation bringing the family size into adjustment with the food supply. In periods of food shortage, the smallest nestling receives no food and quickly dies, thus preventing weakening and possible death of the larger nestlings. Lack notes that marked asynchrony occurs only in species with comparatively long nestling periods, such as

Table 5

Decline in Brood-size with Increasing Age of Nestlings

	Mean weight of nestlings (grams)				
	4–18	19–38	39–68	69–98	109
Number of nests	14	4	11	9	1
Total nestlings	36	10	22	17	2
Males	17	6	13	9	2
Females	16	4	9	7	0
Sex?	3	0	0	1	0
Average number of nestlings per nest	2.6	2.5	2.0	1.9	2.0

hawks, owls, storks, and large passerines; but some degree of "spread" in hatching may also be advantageous in small passerines, such as wrens and tits (Armstrong, 1955:187).

In view of Lack's suggestion, it is worth noting that in most broods in the Montopolis colony there was marked individual variation in size (table 6). Much of this variation cannot be attributed to sexual differences in size and must result from asynchronous hatching and individual variation in rate of growth. In several broods of very small young, direct evidence of asynchronous hatching was obtained. The data from these broods suggest a "spread" of from 2 to 4 days, which is comparable to that reported for the Yellow-headed Blackbird (Roberts, 1909:377; Fautin, 1941*a*:109–110).

Skutch (1954:330) has reported asynchronous hatching in *C. m. mexicanus,* noting that "Only rarely, in nests with two eggs, did both hatch on the same day. More often, one egg hatched each day, so that in sets of three the hatching of all the eggs might require three days; or two might hatch on one day and the third on another day. In a few sets the eggs were marked as laid, and these hatched in the order of laying." With respect to laying, he notes (p. 328) that usually one egg was deposited each day until the set was completed; rarely two days elapsed between the laying of the first and second eggs in sets of two.

In *C. m. major* McIlhenny (1937*a*:282) notes that incubation begins when the second egg (in clutches of three) is laid.

Since hatching is asynchronous in this species, McIlhenny's (1937*a*:283) report of a high frequency of "infertile" eggs in nests of *C. m. major* becomes questionable, especially since his data were obtained by a count, on June 11, 1936, of unhatched eggs *in nests in which the young had just hatched.* He reported that "twelve out of nineteen nests examined contained each one egg that did not hatch, and three out of nineteen nests contained two eggs each that did not hatch." Twenty-five per cent of the 57 eggs laid in the nineteen nests supposedly were "infertile."

At the Montopolis colony, seven of 39 nests in which nestlings were present contained one egg in which embryonic development was not apparent; and two nests each held two undeveloped eggs. With one exception, all nests in which such eggs were found contained two nestlings; and the exceptional nest held three nestlings. I am not sure that

all unhatched eggs belonged to clutches from which the accompanying nestlings hatched, for two eggs taken from a nest containing two female nestlings several days of age (23 and 29 grams) appeared to be fresh. Excluding these two eggs and assuming that no undeveloped eggs were removed by the parent birds or were crushed or knocked from the nests by the nestlings, it is calculated that 6.7 per cent of all eggs layed were "infertile." Possibly a few of the undeveloped eggs examined were addled rather than infertile, but a distinction between these two conditions was not made. In view of McIlhenny's report, it should be emphasized that a 6.7 per cent loss of eggs due to "infertility" is not un-

Table 6

Individual Variation in Nestling Weight in Broods of the Boat-tailed Grackle

Nest number	Sex	Weight (grams)
38	♂ ♂	10.0, 8.8, 4.5[1]
	♀	6.5
76	♂	8.1
	♀	10.5
	sex?	5–6?[2]
1	♂ ♂	11.0, 6.0
	♀ ♀	10.0, 5.0
62	♂	12.3
	♀ ♀	23.0, 18.5, 8.5
105	♂	9.8
	♀	19.5
113	♂ ♂	28.5, 5.5
	♀ ♀	24.5, 12.5
8	♂ ♂	45, 39, 20
74	♂ ♂	77, 25
	♀	59
115	♂ ♂	62, 55, 36
46	♂ ♂	71, 41

[1] Advanced embryo taken from unpipped egg.
[2] Advanced embryo taken from unpipped egg; weight not recorded.

usually high for birds. In the Redwinged Blackbird, Smith (1943:198) found 4.3 per cent of eggs "infertile" (addled eggs included?); and a 6.1 per cent loss due to infertility and addling is reported for the Song Sparrow (*Melospiza melodia*) in California by Johnston (1956:267).

SURVIVAL OF EGGS AND NESTLINGS

The data on brood size provide a basis for estimating the magnitude of losses among eggs and nestlings. With increasing age, as indicated by increasing average weight of all nestlings in a nest, there is a steady decline in average brood size (table 5) from 2.6 in very young broods (4 to 18 grams average weight) to 1.9 in older broods (69 to 98 grams). Undoubtedly there is some further mortality among nestlings before they fledge, for birds in the 69 to 98 grams class probably are 5 to 10 days from fledging. In August, one to three months after fledging, first-year males average 185 grams; first-year females, 114 grams (Selander, 1958:373). The nestling period, as determined by Skutch (1954:245) for *C. m. mexicanus,* is 20 to 23 days.

Comparing figures for average clutch size and average number of nestlings in very young broods, it is calculated that no more than 75 per cent of the eggs hatch. This figure, it should be noted, applies only to successful nests, that is, to those in which one or more eggs hatched; it does not include any nests in which all eggs were destroyed

before hatching. The hatching success of *all* eggs laid probably is somewhat less than 75 per cent. Considering that 6.7 per cent of the eggs laid are "infertile," the hatching success of fertile eggs is calculated to be no more than 80 per cent.

Even assuming that all young of broods in the 69 to 98 grams class survive to fledge, it is apparent that no more than 77 per cent of the hatched young are fledged, or that no more than 58 per cent of the eggs laid give rise to flying young. All things considered, these figures, and that for hatching success, agree rather closely with those for *C. m. major,* the Common Grackle (*Quiscalus quiscula*), reported by Petersen and Young (1950), and the Redwinged Blackbird. Following 74 nests of *C. m. major,* McIlhenny (1937*a*) obtained data from which it can be calculated that 53 per cent of 222 eggs gave rise to flying young. In a major study of the Redwinged Blackbird in Illinois, Smith (1943: table 2, p. 190) found that 72 per cent of 1140 eggs hatched; 82 per cent of hatched young fledged; and 59 per cent of eggs gave rise to flying young. Rather lower values, however, are reported from other studies of this species (see review in Smith, *op. cit.*: 203–204), the Yellow-headed Blackbird (Fautin, 1941*b*), and the Brewer Blackbird (La Rivers, 1944:437).

It is worthwhile noting that the data in table 5 reveal no significant shift in sex ratio among nestlings with increasing age. Similarly, in the Redwinged Blackbird there is no differential mortality in the sexes as nestlings (Williams, 1940:276): among 94 young which successfully fledged, 47 were males and 47 were females. If in fact the tertiary ratios are unbalanced in these species, the imbalance must be attributed to sexual differences in post-nestling mortality.

Since this paper was submitted for publication, field studies in southeastern Texas and southwestern Louisiana have revealed that *mexicanus* and *major* are full species rather than races, for they are sympatric without interbreeding in a 65-mile-wide zone east of Houston and Galveston. Full details of this situation will be presented elsewhere, but it will be convenient to summarize additional information on sex ratios and clutch size at this time.

Three samples of nestlings are available from the zone of sympatry: a large series of *C. mexicanus prosopidicola*, a small series of *C. major major,* and a mixed sample consisting of young which have not been identified as to species; the latter probably includes approximately equal numbers of nestlings of the two species. Sex ratios are as follows:

	No. of nests	No. of nestlings	Male	Female
C. mexicanus prosopidicola	26	53	25	28
Mixed sample	14	32	14	18
C. major major	11	21	9	12

In none of these samples is there significant deviation from an expected 50:50 ratio, but the need for a larger series of *C. major major* is obvious. Combining these samples with that from the Austin region (table 2), we have a total of 189 nestlings of *Cassidix*; of these, 95 were males and 94 were females.

Clutch size in *C. mexicanus prosopidicola* was 4.45±0.16 (σ=0.74), based on 22 completed clutches collected between June 2 and 10, 1959, in the zone of sympatry. Thus clutch size is the same as in the Austin region. Data from eight clutches of *C. major major* yield a mean size of 2.88 (range, 2–3), confirming McIlhenny's report from Avery Island, Louisiana (see page 39).

SUMMARY

The sex ratio of nestling Boat-tailed Grackles (*Cassidix mexicanus prosopidicola*) was determined by dissection of 83 nestlings from a large breeding colony in the Austin

region, Texas. Neither the primary nor the nestling ratio showed significant deviation from an expected 50:50 ratio. A previous report by McIlhenny of a sex ratio strongly unbalanced in favor of females among nestlings in Louisiana is attributed to an unreliable method of sex determination.

Evidence of unbalanced tertiary sex ratios in the Boat-tailed Grackle and other icterids is reviewed, and several sources of error in determination of tertiary ratios are pointed out.

Clutch size in *C. m. prosopidicola* in the Austin region averages 3.45±0.11; clutches of three are most frequent but those of four occur with almost equal frequency; clutches of two and five are unusual.

Marked variation in size among nestlings of the same brood is attributed in part to asynchronous hatching. McIlhenny's earlier report of a high frequency of "infertile" eggs in nests of *C. m. major* is questioned. In the Austin region, an estimated 6.7 per cent of eggs laid are infertile or become addled.

Comparing average clutch size and average number of nestlings in very young broods, it is estimated that hatching success is no greater than 75 per cent. With increasing age, there is a decline in average brood size from 2.6 nestlings in very young broods to 1.9 in older broods. From these data, it is estimated that no more than 77 per cent of hatched young are fledged and no more than 58 per cent of eggs laid give rise to flying young.

Because the nestling sex ratio of the Boat-tailed Grackle is balanced and there is no significant shift in sex ratio with increasing age of the nestlings, any imbalance of the tertiary ratio in this species must be attributed to differential mortality in the sexes following the nestling period.

LITERATURE CITED

Armstrong, E. A.
1955. The wren (Collins, London).

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

Burleigh, T. D.
1958. Georgia birds (Univ. Oklahoma Press).

Chapman, F. M.
1928. The nesting habits of Wagler's oropendola (*Zarhynchus wagleri*) on Barro Colorado Island. Bull. Amer. Mus. Nat. Hist., 58:123–166.

Dickey, D. R., and van Rossem, A. J.
1938. The birds of El Salvador. Field Mus. Nat. Hist., Zool. Ser., 23, Publ. 406:1–609.

Fautin, R. W.
1940. The establishment and maintenance of territories by the yellow-headed blackbird in Utah. Great Basin Nat., 1:75–91.
1941*a*. Iucubation studies of the yellow-headed blackbird. Wilson Bull., 53:107–122.
1941*b*. Development of nestling yellow-headed blackbirds. Auk, 58:215–232.

Friedmann, H.
1929. The cowbirds, a study in the biology of social parasitism (Charles C. Thomas, Springfield, Ill.).

Herman, C. M.
1938. Sex ratios of banded eastern red-wings. Bird-Banding, 9:92–93.

Hickey, J. J.
1955. Some American population research on gallinaceous birds. *In* Recent studies in avian biology (Univ. Illinois Press, Urbana), pp. 326–396.

Johnston, R. F.
1956. Population structure in salt marsh song sparrows. Part II: Density, age structure, and maintenance. Condor, 58:254–272.

Lack, D.
1947. The significance of clutch-size. Part I. Intraspecific variations. Ibis, 89:302–352.
1954. The natural regulation of animal numbers (Clarendon Press, Oxford), 343 pp.
Lack, D., and Emlen, J. T.
1939. Observations on breeding behavior in tricolored red-wings. Condor, 41:225–229.
La Rivers, I.
1944. Observations on the nesting mortality of the Brewer blackbird, *Euphagus cyanocephalus*. Amer. Midl. Nat., 32:417–437.
Laskey, A. R.
1950. Cowbird behavior. Wilson Bull., 62:157–174.
Linsdale, J. M.
1938. Environmental responses of vertebrates in the Great Basin. Amer. Midl. Nat., 19:1–206.
Mayr, E.
1939. The sex ratio in wild birds. Amer. Nat., 73:156–179.
McIlhenny, E. A.
1937*a*. Life history of the boat-tailed grackle in Louisiana. Auk, 54:274–295.
1937*b*. Results of 1936 bird banding operations at Avery Island, Louisiana, with special references to sex ratios and hybrids. Bird-Banding, 8:117–121.
1940. Sex ratio in wild birds. Auk, 57:85–93.
Nero, R. W.
1956*a*. A behavior study of the red-winged blackbird. I. Mating and nesting activities. Wilson Bull., 68:5–37.
1956*b*. A behavior study of the red-winged blackbird. II. Territoriality. Wilson Bull., 68:129–150.
Petersen, A., and Young, H.
1950. A nesting study of the bronzed grackle. Auk, 67:466–476.
Roberts, T. S.
1909. A study of a breeding colony of yellow-headed blackbirds; including an account of the destruction of the entire progeny of the colony by some unknown natural agency. Auk, 26:371–389.
Selander, R. K.
1958. Age determination and molt in the boat-tailed grackle. Condor, 60:355–376.
Skutch, A. F.
1954. Life histories of Central American birds. Pac. Coast Avif. No. 31:1–448.
Smith, H. M.
1943. Size of breeding populations in relation to egg-laying and reproductive success in the eastern red-wing (*Agelaius p. phoeniceus*). Ecology, 24:183–207.
Sprunt, A., Jr.
1958. Eastern boat-tailed grackle. *In* Bent, A. C., Life histories of North American blackbirds, orioles, tanagers, and allies (U. S. Nat. Mus. Bull. 211).
Williams, J. F.
1940. The sex ratio in nestling eastern red-wings. Wilson Bull., 52:267–277.
Williams, L.
1952. Breeding behavior of the Brewer blackbird. Condor, 54:3–47.
Wright, P. L., and Wright, M. H.
1944. The reproductive cycle of the male red-winged blackbird. Condor, 46:46–59.

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