CLUTCH SIZE IN GRACKLES

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Colonies of common grackles (*Quiscalus quiscula*) at Lake-of-the-Woods, Mahomet, Illinois were studied in 1969 and 1970. The birds nested in plantings of scattered pines (Colony ⚹ 1), in hedgerows of multiflora rose (Colony ⚹ 2, an extension of Colony ⚹ 1), and in dense young pine plantings (Colony ⚹ 3). In 1969 many active nests in Colony ⚹ 1 were placed within 10-15' of the ground and were therefore readily accessible for inspection; in 1970 relatively few nests were accessible (most were higher in the trees). Many fewer nests were found in Colonies ⚹ 2 and ⚹ 3 in 1970.

Table 1 presents clutch sizes and fledging success for each year. Differences in success between colonies are generally unexplained. In most of the nests, the nestlings were lost all at once, seemingly independent of age; these deaths were due to predation, desertion (including those due to our disturbance), or being thrown out in high winds (see also Peterson and Young, 1950). In Colony ⚹ 3 in 1969, all losses were of this sort and occurred before the nestlings were more than about 7 days old. In other colonies, nestlings were frequently lost one by one from nests, usually beginning with the smallest and last to hatch. Many of these deaths were apparently of starvation, for the nestlings that died frequently lost weight before disappearing. In a few cases (for example the clutch of seven eggs in 1970) the nest was apparently too small to contain all the growing nestlings and became very flattened before the nestlings were old enough to hold on properly, so that the young gradually fell out; in some cases the nests may have been poorly constructed. The gradual disappearances generally began at about 5-7 days of age in both years, and usually more than one nestling died. The data are inadequate to compare age-specific death rates in broods of different sizes. For 22 nests in which 5 young hatched, 89% (in 1969) died before fledging, in 9 nests with 4 hatchlings, 69% died as nestlings. But because most of these losses were sudden and complete, we cannot assert that starvation-related death rates were greater for larger broods.

Hatching success varied greatly, and in terms of losses of the whole clutch, affected c/5 and c/6 relatively more than c/4. Whole-clutch losses were greatest in Colony ⚹ 3 in 1969, and in Colony ⚹ 1 in 1970, where almost half the completed sets were lost before hatching.

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The major predators seemed to be crows, which were seen lurking in the pine-tree tops and snooping in tufts of needles similar to those used by grackles for nesting. Squirrels (*Sciurus* spp.), Blue Jays (*Cyanocitta cristata.*), and "small boys" (*Homo sapiens*) were other potential diurnal predators, but were seldom seen in the nesting areas. Possible nocturnal predators include opossums (*Didelphis virginianus*), and raccoons (*Procyon lotor*). The hedgerow nests were well protected from predators by the array of thorns; the greater losses among these nests in 1970 may be related to our more determined visitations. Grackles seem noticeably more disturbed by strange objects in and around the nest than are Yellow-headed Blackbirds (*X. xanthocephalus*), and may have destroyed their own nests in their agitation.

Clutch size frequencies for a grackle colony nesting in junipers at Kickapoo State Park, Danville, Illinois in 1965, are also presented in Table 1 (courtesy of J. R. Karr). For 23 nests at Lake-of-the-Woods in the same year, Long and Long (1968) found an average clutch size of 4.2 eggs. Jones (1969) and Johnston (1964) found an average clutch of 4.7 eggs; Peterson and Young (*op. cit.*) reported an average clutch of 4.9.

Growth of nestlings was measured in 1969 in Colony ⚡1, and is presented in Table 2. Adult grackles are highly dimorphic in size (Snyder, 1937; Stevenson, 1933; Rand, 1961) and male and female nestlings differ in size before they leave the nest. The extreme weight losses of some nestlings makes difficult the separating of males and females without more precise aging (see Willson, 1966), but by the age of about 13 days, a consistent difference was present in both weight and tibiotarsal length. Supposed males at this age weighed over 75 g., with a tarsal length of 3.3 cm or more; supposed females weighed less than 64 g., with a tarsal length of less than 3.1 cm. The data do not permit comparison of growth rates for broods of different sizes.

Grackle parents foraged for their young at rather great distances from the nests: in extensive areas of short grass in the adjacent golf course and park areas, and along the banks of the lake and the Sangamon River. They flew over a quarter of a mile from the colony on several occasions. Attempts to take food samples from the nestlings by the pipe cleaner neck-ring technique met with difficulties; clean, white pipe cleaners were thrown out of the nest, with attached nestlings. Dirty pipe cleaners were more successful, but we did not pursue the matter. Three food samples from nests of older nestlings yielded earthworms, isopods, and adult cicadas. Other studies (Gabrielson, 1922; Hamilton, 1951; Snelling, 1968) indicate that nestlings grackle receive a wide variety of food.

We originally embarked on this project to investigate the now-old questions concerning the regulation of clutch and brood sizes: "Do animals tend to rear as many young as they can?", where food, protection, temperature control, parental maintenance, etc. must all be considered, and "is the most successful clutch size the

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TABLE 1. CLUTCH SIZE AND FLEDGING SUCCESS OF GRACKLES IN CENTRAL ILLINOIS, BASED ON NESTS IN WHICH THE CLUTCH WAS BELIEVED TO BE COMPLETE

Lake-of-the-Woods	# nests	X̄ Clutch size	# young fledged/nest X̄	estimated hatching dates
1969 Colony #1*	c/4 3		1.33	May 1, 1, 4, 4, 5, 5, 6, 6, 6, 6,
	c/5 17	X̄ = 5.0	0.0	7, 11, 11, 11, 13, 14, 19
	c/6 4		0.0	X̄ = May 8
	—— 24			
Colony #2	c/2 1		1.00	May 1, 3, 3, 4, 5, 8, 9,
	c/3			11, 11, 11, 12,
	c/4 3	X̄ = 4.9	1.33	17, 18
	c/5 10		1.20	X̄ = May 9
	c/6 4		1.25	
	—— 18			
Colony #3	c/4 8		0.0	May 3, 5, 5, 5, 6, 11, 13,
	c/5 15	X̄ = 4.7	0.0	15
	c/6 1		0.0	X̄ = May 8
	—— 24			
Grand means		4.9	0.4	

*2 c/2 and 1 c/3 were assumed to be incomplete, 4 completed nests were never observed to contain an egg.

Lake-of-the-Woods	# nests	$\bar{X}$ Clutch size	$\bar{X}$ # young fledged/nest	estimated hatching dates
1970 Colony #1*	c/4 2 c/5 5 c/6 1 c/7 — 8	$\bar{X} =$ 5.0	1.5 1.2 0.0	May 6-12 (3 nests), 12, 12, 14, 14, 24 $\bar{X} =$ May 13
1970 Colony #2	c/5 4 c/6 3 7	$\bar{X} =$ 5.4	2.3 0.0	May 6-12 (4 nests), 16 $\bar{X} =$ May 10
Colony #3	c/5 4	$\bar{X} =$ 5.0	0.0	May 17, 18, 22
Grand means		5.2	0.9	$\bar{X} =$ May 19

*Several completed nests appeared to be unused.

Kickapoo State Park (courtesy of J. R. Karr)

1966				
c/2 1 c/3 6 c/4 21 c/5 29 c/6 1 58	$\bar{X} =$ 4.4			

TABLE 2. GROWTH RATES OF GRACKLE NESTLINGS; MALES AND FEMALES ARE AVERAGED TOGETHER (SEE TEXT). SAMPLE SIZES ARE GIVEN IN BRACKETS.

Approx. age days	$\bar{X}$ wt (g)	range	$\bar{X}$ tarsal length (cm)	range
1	6.1 (5)	4.8–6.7		
2				
3	11.8 (24)	5.5–21.2		
4	22.5 (2)	21.3–23.7		
5	26.3 (32)	15.8–39.2	1.7 (9)	1.7–1.9
6				
7	41.0 (33)	19.3–60.8	2.2 (19)	1.9–2.7
8				
9	50.9 (18)	31.0–67.3	2.7 (23)	2.0–3.3
10				
11	65.4 (8)	53.3–81.2	3.1 (5)	2.9–3.4
12				
13	70.1 (4)	56.6–83.8	3.2 (4)	3.0–3.5

most frequent?" Our intent was to alter the sizes of natural clutches to create artificially large and small broods, to follow the growth rate of the nestlings in order to predict their survival as fledglings. Perrins (1963) showed that weight of young titmice at fledging influenced their later survival, and that young from large broods tended to weigh less than those from small broods (see also Harris, 1964, on nestling weights of 2 species of *Larus* and Moss and Camin, 1970 on purple martins *Progne subis*) although Dunnett (1955) and Paynter (1954) could show no differences in starling (*Sturnus vulgaris*) and tree swallow (*Iridoprocne bicolor*) nestling weight with brood size. Artificial changes in brood size in titmice and various seabirds have yielded variable results (Klomp, H. 1970; Lack, 1966; Rice and Kenyon, 1962; Nelson, 1964; Harris, 1966). Aside from Lack's own work, and that of his associates, on swifts and titmice especially (summarized in Lack, *op. cit.*; Lack, 1956, and references therein), studies of natural survival relative to clutch or brood size have been quite rare, and generally suffer from one or more deficiencies: inclusion only of nests fledging or hatching at least one young, survival of fledglings and juveniles unknown, etc.

A partial review of papers relating clutch size frequencies with "fledging" success (Paynter, *op. cit.*; Jansson, 1960; Owen, 1959; Delius, 1965; Harris, *op. cit.*, 1967; Rowan, 1969, Seel, 1968, 1970; Willson, *op. cit.*; Ward, 1965; Lack, 1948, Paynter, 1949; Lockie, 1955) shows that commonly the most frequent clutch size is smaller than the most *successful* one, as noted also by Mountford (1968)

and Klomp (1970). Allowing for some post-fledging mortality, the most successful clutch size might become the most frequent, but the case is far from proved. Reanalysis of Lack's own titmouse data for natural broods (1966, Tables 7 and 8) shows that in fact the commonest clutch size is very seldom the most successful, unless many of the data presented are thrown out for other reasons. Furthermore, if the proposition is true that the most successful clutch size should be most frequent, it should follow that the second most successful clutch size should be the second most frequent and so on, but this is seldom observed to be so.

In view of the considerable and presumably adaptive variability of clutch size and nesting success with geographic region, season and time of breeding, weather, and age of the female parent, and even of age of mate and duration of the pair, all of which are amply documented in the literature (see especially Klomp, *op. cit.*, for a good review), it is clear that any analysis of relative success of different clutch sizes must attempt to control these variables. Even if that could be done, because of the possible importance of the pre-laying conditions in determining the number of eggs laid (Perrins, 1965; Ryder, 1970), of parasitism (Moss & Camin, *op. cit.*), and of nest-parasites (Smith 1968), and other sources of error which make birds imperfect predictors of the environment, one would expect some deviation from the best potential strategy within a single genotype. This, according to Mountford (*op. cit.*), may cause the most successful clutch size to differ from the most common one, even when all obvious adaptive variation has been accounted for. Deviations should be expected particularly in situations where food supply, weather, habitat conditions and such are highly difficult to predict accurately.

We concluded that, with all these difficulties, *we* could not hope to demonstrate an answer to the original questions, even as generalized by Cody (1966), Ricklefs, (1968, 1970) and to some extent by Skutch (1949, 1967). Grackles, as well as Yellow-headed Black-birds (Willson, *op. cit.*) and other species (e.g., Chapman, 1955; Jehl and Hussell, 1966; Power, 1964) can be greatly affected by weather conditions at critical stages in the nesting cycle. In the Lake-of-the-Woods grackle colonies, there were 42 instances of disappearing nestlings in 1969, and 36 (86%) of these were on or just after days of rain, in 1970, 21 of 34 disappearances (62%) occurred during or after rainy periods. However, the month of May in both years was recorded as warmer and drier than normal for the area by the State Water Survey in Champaign-Urbana. In many continental temperate areas, the most predictable aspect of weather is that it is unpredictable, so that many years would be needed to adequately test Lack's hypotheses and their modifications (see also Cohen, 1967). The question may be more easily answered in theory than in actuality.

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