

eggs comprised 2.8% of all eggs. Five complete clutches of white eggs contained 26 eggs (3.3% of all eggs). The mean clutch size was 5.2 eggs (5, 5, 5, 5, 6). In total, therefore, 6.1% of all eggs were abnormally pigmented. No pale blue or white eggs occurred in clutches with normally colored eggs.

The hatching rate for normal eggs was 91.2% (718/789). Of the 22 pale blue eggs, 21 hatched (95.5%), and 25 of the 26 white eggs hatched (96.1%). The fertility rate, therefore, was high in all eggs. The fact that all of the clutches contained either completely normal or completely abnormal eggs suggests that albinism is a trait of individual females. This contrasts with Power's finding of infertile white eggs in clutches with fertile normal eggs, which would suggest that albinism is a function of individual eggs. This contrast may indicate that different phenomena are operative in the two samples. Our data suggest, however, that fertility is not related to color in Mountain Bluebird eggs. *Received 30 June 1980, accepted 16 September 1980.*

Black Vulture Nesting, Behavior, and Growth

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Black Vultures (*Coragyps atratus*) have nested for 5 consecutive yr (1975–1979) on a small island in Gatun Lake, Panamá. The 1975 nest site (McHargue 1977) was 6 m from nests of the following 3 yr, which were all within 1 m of each other. The 1979 nest site was 35 m distant, in the same location as that used by a pair of Turkey Vultures (*Cathartes aura*) in 1975 (McHargue 1977).

Two eggs were laid about 13 December 1975 (estimated from the known fledging date of young), 28 October–6 November 1976, 16 November 1977, 12–18 November 1978, and about 10 October 1979 (estimated from development of young). Ranges represent the time between the day I last searched the area for eggs and the day eggs were found. Two young hatched and fledged in 1975 and 1976. In 1977 and 1978 only one young hatched; one of the 1977 eggs broke between 16 and 18 December, 6–8 days before the other egg hatched, and one of the 1978 eggs disappeared between 15 and 22 December, 4–12 days before hatching. The 1977 young fledged, but the 1978 young disappeared when 4–8 days old. Two young hatched in 1979 and were both present when 40 days old, after which time I could no longer observe them.

The 1976 nestlings hatched on 13 and 15 December, after an incubation period of 37–48 days. Incubation times were 38 days in 1977 and 38–45 days in 1978. The 1976 young fledged about 6 March 1977, when 81 and 83 days old. The 1977 young was still near the nest when 90 days old, but it is not known if it could fly.

In 1976 I banded the nestlings after the second one hatched and weighed them on a double pan balance about every 3 days in the late afternoon. I estimated the fullness of their crops for each weighing during the last half of the nestling period. The nestlings never regurgitated when handled. Photographs were taken at weekly intervals. Twice during the first month I tried to observe the nest site from a blind. The adults, however, were very wary, and my presence often kept them from the nest. Consequently, except to remove the nestlings for weighing or photographing, I left the nest area undisturbed in order not to interfere with normal care by the adults. If one of the adults was brooding when I came to remove the young, it usually ran a short distance and then flew into the branches of a tree, returning to the nest site about 20 min after I had returned the nestlings.

Figure 1 shows the first-hatched nestling at 2-week intervals from 9 to 79 days after hatching. The young at hatching were covered with very dense down. The first feathers appeared on the wings about 23 days later. Nestlings over 25 days old changed their resting location frequently but remained around the base of the palm clump where the eggs had been laid. With advancing age, they became increasingly more mobile and difficult to catch.

The second-hatched nestling was always more aggressive toward me than the first-hatched bird. I observed the younger nestling at 11 days after hatching strike at and grasp the older one with its bill after both had been fed simultaneously by an adult.

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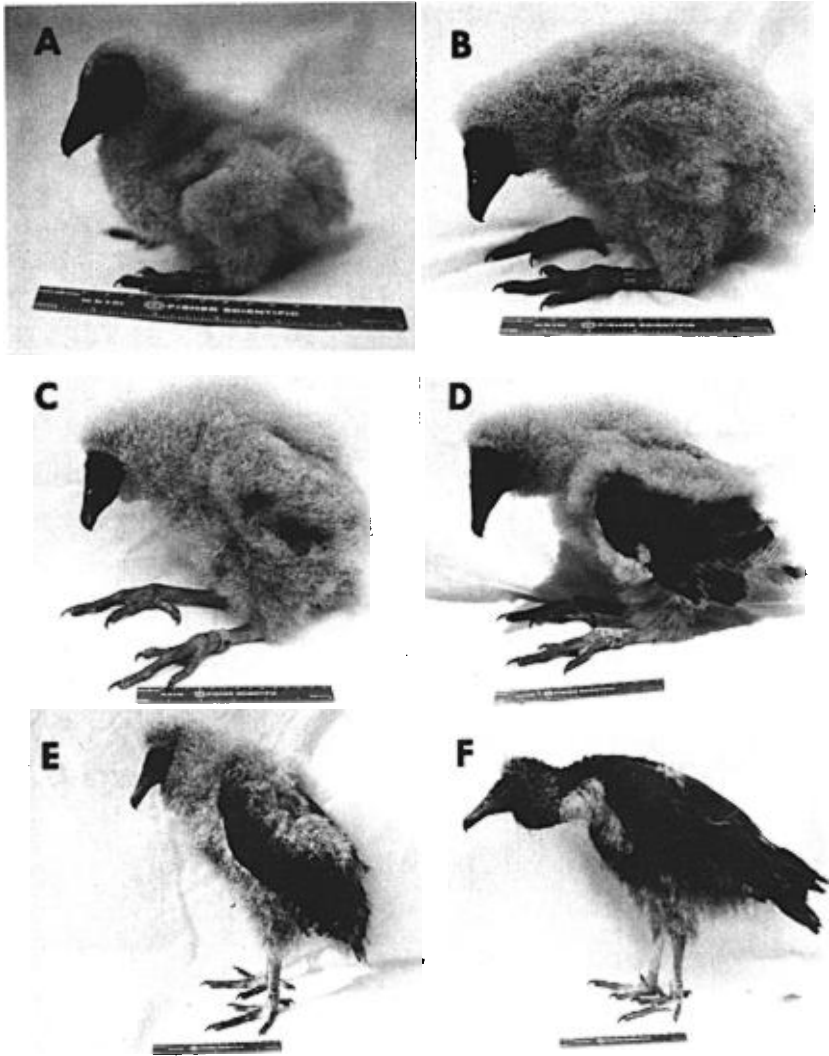


Fig. 1. Development of the older Black Vulture nestling. A: 9 days after hatching; B: 23 days; C: 37 days; D: 51 days; E: 65 days; F: 79 days.

I first observed wing-spreading or "basking" behavior by the young when they were photographed at 5 weeks, although I had moved them from their shaded nest site into bright mid-afternoon sun for photographing on all previous occasions. At 5 weeks the black tips of their developing primaries protruded 1–2 cm from the sheaths and were tipped with down; the feathers were barely visible when the wing was held against the body (Fig. 1C). The young could not raise their wings far off the ground or keep them extended for long. At 6 weeks, however, the birds were capable of holding the wings out and off the ground and were standing with greater facility.

The nestlings were not wet when they spread their wings, so they were not drying their feathers. The nestlings had been moved from a cool area into bright sun, and wing spreading probably facilitated cooling. When they exhibited this behavior at 6 weeks, they also panted and directed excreta onto their legs, cooling mechanisms in the Wood Stork (*Mycteria americana*) (Kahl 1963) and Turkey Vulture (Hatch 1970). Exposing the bare underwings, as in the Turkey Vulture's uncovering skin on the neck in response to high temperatures (Hatch 1970), probably served to dissipate heat. It is noteworthy that at 6 weeks and later when they spread their wings during photography, the nestlings stood up and oriented

TABLE 1. Weights of two sibling Black Vultures from 0 to 81 days from hatching. Weights taken on the same dates beginning 15 December when the second nestling hatched.

First-hatched nestling		Second-hatched nestling	
Days from hatching	Weight (g)	Days from hatching	Weight (g)
2	81.3	0	70.9
5	138.4	3	106.1
8	191.0	6	143.0
12	262.0	10	193.5
14	401.5	12	303.5
17	533.5	15	493.2
20	554.5	18	493.0
23	795.0	21	690.0
26	923.7	24	852.0
29	1,078.5	27	915.5
32	1,141.0	30	1,065.3
35	1,189.1	33	1,110.4
38	1,323.7	36	1,254.2
41	1,402.8	39	1,284.5
44	1,418.5	42	1,330.1
47	1,585.0	45	1,646.0
50	1,610.2	48	1,532.5
53	1,590.6	51	1,500.6
57	1,741.1	55	1,661.9
59	1,743.1	57	1,612.6
62	1,571.5	60	1,569.7
65	1,703.2	63	1,649.2
68	1,677.9	66	1,629.2
71	1,785.4	69	1,812.4
81	1,670.0	79	1,757.8

their wings parallel to the sun's rays, not perpendicularly, as would be expected if they were maximizing insolation.

Table 1 presents weights of the two young from hatching to just before fledging. Both gained weight fairly steadily until about 50 days after hatching. The second-hatched nestling, however, was the same weight on 2 consecutive weighing days (15 and 18) and lost 114 g between days 45 and 48. The very high weight recorded for the second-hatched nestling on day 45 was due to a very full crop.

After 50 days the nestlings' weights fluctuated, changing by as much as 180 g (about 10% of final weight) within 3 days. Stewart (1974) noted that a pair of Black Vultures in Virginia brooded their young for 43 days after hatching, during which time feeding was frequent; after 43 days the young were fed only three or four times per day. Weight fluctuations in the Panamá young may have been the result of less frequent feedings. Low and high weights after 50 days correspond to empty or more than half-full crops, respectively.

A comparison of growth parameters (see White and Brisbin, in press) for the two nestlings done by Dr. Gary C. White of the Los Alamos Scientific Laboratory showed no difference in their growth curves. Asymptotic weight (1,710 and 1,692 g for the first- and second-hatched young, respectively), the growth rate constant (K) for the Richards' growth curve (0.570 and 0.648), and " m ," a shape parameter (1.148 and 1.126), were not statistically different. These results differ from those obtained by White and Brisbin (in press) for four sibling Barn Owl (*Tyto alba*) nestlings. They found that K and m were relatively constant within the clutch but that asymptotic weight was not, suggesting stronger genetic control of K and m than of asymptotic weight, which was affected by environmental factors (i.e. unequal sibling competition due to hatching order). This may be explained by the facts that a clutch size of two may not be sufficient to effect a change in any of the growth parameters for Black Vultures or that vultures grow differently with respect to the relation of their sibling growth curves than do Barn Owls.

To compare the Black Vultures' growth with that of other altricial and semi-altricial land birds, I estimated growth parameters by the method of curve fitting detailed by Ricklefs (1967). Using an asymptotic weight of 1,700 g for both nestlings, I found that the Gompertz equation best fit growth curves to 53 and 51 days after hatching for the first- and second-hatched nestlings, respectively, excluding day 45 for the younger nestling. Growth rates (K) are comparable among species with growth curves fitted by the same equation or when transformed to correspond to parameters obtained by different equations

(Ricklefs 1973). The Black Vultures' growth rates (0.079 and 0.068) are 20–30% lower than Ricklefs' (1973) expected value for altricial and semi-altricial land birds of comparable adult weight.

The slow growth of Black Vultures may be related to precocity of development compared to faster growing raptorial birds (see Ricklefs 1973); the nestlings' dense down may indicate early development of homeothermy. Alternatively, slow growth may be related to the nutrient content of their food, i.e. the extent to which fruits or other plant material comprise their (presumably) mostly carrion diet. In addition, there may be energy limitations imposed by their dependence on carrion for food. Carrion may be an unpredictable resource in time and space, due to both the variability of its occurrence and to conditions limiting foraging activity. Hatch (1970) observed Turkey Vultures remaining on their roosts for 2 days in rainy weather, while Stewart (1974) observed that Black Vulture young that were normally fed several times daily were not fed on a rainy day. The reduced growth rates of Black Vulture young may be adaptive in ameliorating the "feast or famine" nature of scavenging.

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Song and Territory Defense in the Red-winged Blackbird

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Song is presumed to function as a long-range territorial advertisement in many species of birds, but surprisingly few studies have attempted to test this presumption (Krebs 1977). Experimental studies of territory defense in the Red-winged Blackbird (*Agelaius phoeniceus*) by Peek (1972) and Smith (1979) have shown that surgically devocalized males incur higher rates of trespass by conspecifics and are more likely to lose their territories than normal singers or sham-operated control males. These studies indicate that Red-winged Blackbird song plays an important role in territory defense, but they do not directly test the effect of song alone, as visual displays are also important advertisement signals (Peek 1972, Smith 1972). In addition, Smith (1976) has shown that surgically devocalized male Red-winged Blackbirds can successfully maintain their territories even though they are unable to produce species-typical songs. I attempted a more direct test of the hypothesis that Red-winged Blackbird song functions in territory defense by conducting speaker-occupation experiments (Krebs 1977).

Experiments were conducted from 21 March to 29 May 1979 at the Cary Arboretum of the New York Botanical Garden in Dutchess County, New York. Male Red-winged Blackbirds in the study population defended relatively large territories (ca. 4,000 m²) in upland habitats. I captured 38 male Red-winged

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