

20,000 m² or 75 per km². For species C, the estimated density is 0.2 birds per 20,000 m² or 10 per km². A generalized equation for this procedure is:

$$D = \frac{n}{l \times d \times 2} \times \frac{10^6 \text{m}^2}{\text{km}^2},$$

where D = density of birds (number per km²), n = number of birds observed between transect line and outside edge of last interval used in density estimate, l = length of transect in meters, d = number of meters from transect line to outside edge of last interval used in density estimate, and where the last interval used is that which gives the largest mean number of birds per meter of lateral distance.

This method of analyzing transect counts emphasizes the use of data obtained in the first interval from the transect line. Sightings outside of the first interval are of interest only when, due to small sample size, the number of individuals is largest in an interval other than the first. The logical and mathematical basis for this approach is given by Stoddart (Gross, Stoddart, and Wagner 1974, Wildl. Monogr. 40). No attempt is made to establish a species specific "sighting probability" (Eberhardt *ibid.*) or "coefficient of detectability" (Emlen *ibid.*), because few species occur with sufficient frequency to do so feasibly.

There may be some problems in treating the data in the manner described. The procedure assumes that the numbers of birds seen in the intervals used in the density estimate represent the actual numbers of birds present in those intervals. Since in most cases a progressively smaller proportion of the individuals present are likely to be seen at increasing distances from the transect line, the use of data from intervals other than the first to maximize the density of a particular species may result in an underestimated density figure for that species. However, we believe that the technique described is an adequate solution to the problem of making density estimates for all bird species encountered along a transect.

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Eleven-day incubation by an American Robin.—At a nest of the American Robin (*Turdus migratorius*) that I watched at Woodlawn, Baltimore County, Maryland, in 1976 the third and last marked egg of the clutch was laid 10 May between 1028 and 1155 EST and hatched 21 May between 0736 and 1013. Thus its incubation period was somewhere between 10 days 19 hr 41 min and 10 days 23 hr 45 min, or 10 days 21 hr 43 min \pm 2 hr 2 min. This appears to be the first 11-day incubation period ever documented for this species.

Young (1955: 337) reported some periods of 10 and 11 days, but he confirms (*pers. comm.*) what his text indicates: that he computed the period as the time from the laying of the last egg to the first hatching. Eaton (1914: 531) and Forbush (1929: 407) both gave 11 days as the minimum period but without any supporting data.

Howell (1942: 565), timing the marked last eggs of 17 clutches at Ithaca, New York, in the modern manner—from the laying of that egg to its hatching—found periods of 12–14 days. Kendeigh (1952: 127) reported 13 instances of 12 days and 8 instances of 13 days at Gates Mills, Ohio, and Schantz (1939) reported "about 13 days" for 2 closely watched nests at Columbus, Ohio.

In years before 1976 I made 19 determinations at Baltimore, Maryland. Fourteen marked and 5 unmarked last eggs all hatched on the 12th day after they were laid. Within that period of "days," however, there has been variation from 11 days 18 hr 36 min \pm 40 min to something over 12 days 6 hr 50 min. A 20th egg hatched on the 13th day, but I am not sure that that was not really a penultimate egg, I possibly having caused one later egg to be dropped away from the nest.

In view of all these other careful determinations, the 11-day period timed in 1976 appears to be definitely abnormal, rather than a part of normal variation.

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Morphological and behavioral development of the Mandarin Duck.—Although the literature of the Mandarin Duck (*Aix galericulata*) contains general naturalistic accounts (Savage 1952), little has been published on its biology and early development. Because of its widespread aesthetic appeal, this species occurs in many private breeding collections and zoos. This study compared egg morphology from known-age females and determined anatomical and behavioral growth rates of the ducklings (Bruggers 1974).

The study was conducted at the 10-ha estate of Mr. and Mrs. J. J. Schedel, Elmore, Ottawa Co., Ohio. Adult ducks had one wing pinioned and were either maintained in large outdoor lake-side pens or were free-ranging on two 0.6 and 1.0 ha interconnected lakes. Nest boxes were in the pens surrounding the lakes.

Nests were checked every other day during the laying period while adults were absent. All eggs were marked, measured with calipers, and weighed on a torsion balance at days 1 (fresh weight), 15, and at pipping. The shell membrane was removed following hatching and the shell thickness measured with an Ames Thickness Measure modified for curved surfaces. An average thickness for each egg was calculated from five readings taken around its center.

Body weight, culmen length and width, tarsus and middle toe lengths, and feather development of 5 males and 8 females were recorded at hatching and at one-week intervals during the summer. Measurements were made with vernier calipers, duplicating the methods of Northern Prairie Wildlife Research Center (Greenwood 1974).

The 13 ducklings were hatched under bantam hens within a 2-week period, individually marked, then reared successively in brooders, indoor pens with ponds, and lake-side pens. They were given a commercial starter diet.

Mandarin eggs are glossy and buff-white. The average length and the average maximum width of 106 eggs from 11 clutches was 52.86×38.64 mm, smaller than the 56×39 mm for eggs laid by Mandarins in Japan (Nakata 1965), but slightly larger than the 48.8×36.3 mm of 18 Mandarin eggs from England (Savage 1952). Width was less variable than length, a condition also noted by Preston (1958) for the eggs of many bird species.

Fresh egg weights averaged 43.72 g, similar to the 43-g average of 68 eggs provided by J. Kear in England (pers. comm.). Weights and lengths of eggs laid by second-year or older birds (46.26 g and 53.74 mm) were significantly greater ($P < 0.05$) than of those laid by yearling females (42.68 g and 55.52 mm), a phenomenon reported in many species (Romanoff and Romanoff 1949, Preston 1958). Egg weight decreased 10.5% (43.75 to 39.1 g) during development, which Romanoff (1967) ascribed to water evaporation. The shell thickness of 60 eggs (11 clutches) averaged 0.259 mm (range: 0.191-0.329 mm). This variation resulted from significant differences between clutches and the inclusion of shells from infertile eggs.

Ducklings weighed 20-30 g 12-36 hours after hatching (also recorded by Smart 1965 and J. Kear, pers. comm.), with males (29 g) heavier than females (25 g) (Fig. 1). Similar sexual dimorphism was reported (Prince et al. 1970) for Mallards (*Anas platyrhynchos*). Both sexes doubled their hatching weight in 1 week and were 13 times heavier after 5 weeks. Males averaged 100 g heavier than females at 6 weeks. Adult weight was attained after the first prealternate molt in October, a pattern similar to Wood Ducks (*Aix sponsa*) (Lee, pers. comm.).

The growth rate slowed during the physiologically stressful fledging period, body weight increasing only 8% (males) to 11% (females) during that time. Female Greenland Mallards (*A. p. canboschas*) gained only 55 g between the 6th and 8th weeks (Greenwood 1974), and Weller (1957) and Kear (1970) observed actual decreases in growth curves of Redhead (*Aythya americana*) and Tufted Duck (*Aythya fuligula*).

Rapid tarsus development, characteristic of pochards (*Aythya*) and presumably an adaptation for aquatic birds (Kear 1970), was complete by 6 weeks. This rapid growth in Mandarins (and probably Wood Ducks) also may be an adaptation to terrestrial locomotion. The ducklings spent considerably more time walking and picking at insects than swimming, a phenomenon also noted by Savage (1952) for wild Mandarin broods. Both he and Stewart (1958) observed movements of wild, newly-hatched duckling broods up to 5.6 km from the nest to reach water.

Newly-hatched Mandarin Ducks are brown dorsally and buff-yellow ventrally, with two light dorsal spots. The bills of both sexes have a conspicuous orange tip, an epimematic pattern by which parents