

The crane-hawk also approached the tree directly, grasped the bark with both feet, and hung vertically along the trunk maintaining its position by vigorous flapping (Figure 1), the wings clapping against the trunk with each downstroke. It then freed one foot, which it extended into the crevice by rotating the tarsometatarsus backward. On another trip the hawk hung upside down while it plucked an insect from a crevice extending *upward* along the trunk.

I watched the hawk capture food nine times. After each capture it carried its prey to a nearby tree, removed the wings, and ate it in three or four small bites. Approximately 5 minutes elapsed between captures. Later I removed several pieces of bark from the feeding tree, under which I found many katydids (Family Tetigoniidae) averaging 3 inches in length. Wetmore (*Proc. U. S. Natl. Mus.*, 93: 241, 1943) has reported orthopterans in the diet of this hawk.

These observations were made while I was a participant in the Organization for Tropical Studies' field course in the Biology of Tropical Vertebrates. Preparation of this report was supported in part by a National Science Foundation grant to The University of Michigan for research in Systematic and Evolutionary Biology, NSF GB-3366.—JOSEPH R. JEHL, JR., *The University of Michigan Museum of Zoology, Ann Arbor, Michigan, 48104. Present address: San Diego Natural History Museum, P. O. Box 1390, San Diego, California 92112.*

**Clutch size, incubation period, and nestling period of the American Goldfinch.**—During the period 1947–1963, inclusive, I examined 863 nests of the American Goldfinch (*Spinus tristis*) in the vicinity of Ann Arbor, Michigan. Many of these nests were destroyed or deserted during the egg-laying, the incubation, or the nestling period; a very few nests were visited only once. Some 216 nests were found after one or more eggs had hatched so that a precise determination of the clutch size was impossible. I felt that accurate determination of clutch size was made for 474 nests (Table 1):

TABLE 1

Clutch size	Number of nests
2	4
3	13
4	116
5	242
6	98
7	1

The first nests were found in June in three years: 11 June 1947 (Berger, 1948); 28 June 1954; 30 June 1959. In all the other years, except for three when I was away from Ann Arbor in July, first nests were found under construction during the first week of July (1–7 July).

The first egg in the 2-egg clutches was laid in the four nests, respectively, on or about 8 August, 22 August and 31 August (two nests). The first egg in the 13 3-egg clutches was laid between 10 August and 4 September. The first egg of 6-egg clutches was laid as early as 16 July (nest 30–1955) and as late as 27 August (nest 7–1947). All but four of the 6-egg clutches were begun before 15 August. The first egg in the 7-egg clutch was laid on 9 August (nest 8–1958).

Marked annual differences in the number of 6-egg clutches are suggested by the following data: 5 per cent of 186 clutches, 1955; 16.5 per cent of 127 clutches, 1956; 8.6 per cent of 46 clutches, 1957; 15.1 per cent of 212 clutches, 1958.

Walkinshaw (1938-1939) reported clutch size in 73 nests to vary from 3 to 6 eggs. Stokes (1950) found the clutch size in 150 nests to vary from 2 to 7 eggs.

Walkinshaw gave the average measurements of 93 goldfinch eggs as  $12.4 \times 16.5$  mm, with two extremes of  $11.5 \times 19.0$  and  $11.5 \times 15$  mm. I found three "abnormal" eggs. These measured:  $9.7 \times 12.9$ ;  $11.5 \times 18.2$ ; and  $11.0 \times 14.7$  mm. None of these eggs hatched.

The eggs of the American Goldfinch typically are immaculate bluish-white. Sometimes eggs are laid containing cinnamon-colored spots or flecks, usually concentrated around the larger end of the egg. Of 2,479 eggs I observed, 28 (1.12 per cent) had such markings. These 28 eggs were found in 11 nests. In four nests only one spotted egg was found among clutches varying from 2 to 6 eggs. All of the eggs were spotted in one clutch of 2 eggs, in four 4-egg clutches, and in one clutch of 5 eggs. Another nest containing a single spotted egg was destroyed before I visited the nest again.

Except for two general statements in the literature, spotted eggs of the American Goldfinch apparently have not been mentioned by earlier writers. Sutton (1959a) stated: "Goldfinch eggs are, very rarely, finely spotted with brown." Berger (1961: 237) noted that, among birds that typically lay immaculate eggs, "spotted eggs have been reported for the Eastern Phoebe, Lazuli Bunting, Indigo Bunting, Lesser Goldfinch, and American Goldfinch." Linsdale (1957: 57) reported that one egg of a set of four eggs of the Lesser or Green-backed Goldfinch (*Spinus psaltria*) "was finely dotted with reddish brown." (See Bent, 1967: 456.)

I knew that 11 (1.27 per cent) of 865 goldfinch nests had been parasitized by the Brown-headed Cowbird (*Molothrus ater*). I reported earlier on two double-storied nests containing a total of four embedded cowbird eggs (Berger, 1948). Included in the total of 865 nests are two nests found (23 August 1955, 9 September 1958) after one or more young goldfinches were presumed to have fledged from the nests because of the accumulation of droppings on the nests. One of these nests had two cowbird eggs embedded in the lower story. I found one double-storied goldfinch nest (nest 36-1949) with one goldfinch egg only in the lower story.

Walkinshaw found no parasitism among 111 nests examined. Stokes found parasitism of one nest out of a total of 230 nests he studied. Nickell (1951) mentioned one parasitized nest out of a total of 264 nests.

I have never observed a goldfinch feeding a fledged cowbird. In my nests only one of 11 cowbird eggs hatched. One cowbird egg hatched between 5:10 PM 23 July and 5:30 PM 24 July 1953, but the cowbird was dead by 9:30 AM on 25 July. The first goldfinch egg in this nest hatched 26 July. Nickell (1951) recorded a nest in which three young cowbirds died in the nest. Sutton (1959b) stated that he had never seen a goldfinch caring for a fledged cowbird. Friedmann (1963: 148), however, believes that cowbirds have been fledged from goldfinch nests.

My field work was concentrated on areas in which hawthorn (*Crataegus* sp.) was the dominant shrubby vegetation (Berger, 1957), and about 71 per cent of my goldfinch nests were built in *Crataegus*. The average measured height above ground of 583 *Crataegus* nests was 53.3 inches; the range in height varied from 27 to 110 inches.

Lewis (1952) reports the average height above ground of 591 nests of the American Goldfinch built in thistles (mostly *Cirsium altissimum*) to be 4.04 feet.

My data confirm the statement by Walkinshaw (1938-1939) that the incubation period of the American Goldfinch varies from 12 to 14 days. In one of my nests containing one cowbird egg and four goldfinch eggs, however, the first (and only) goldfinch egg to hatch did so after 15 days of incubation.

In 1953 I reported (Berger, 1953b) an instance of a female American Goldfinch

that incubated a clutch of five eggs for at least 23 days. Two additional examples of protracted incubation periods were found in 1955. The female at nest 45-1955 incubated five eggs for a minimum of 26 days, but less than 30 days, before deserting the nest. The female at nest 87-1955 incubated her clutch of five eggs for a minimum of 25 days, but less than 32 days, before deserting.

These additional examples of protracted incubation behavior suggest, as I pointed out in 1953 in summarizing other data from the literature, that broodiness behavior in passerine birds seems to last about twice the length of the normal incubation period. Linsdale (1957: 87) however, reports a female Lawrence's Goldfinch (*Spinus lawrencei*) that deserted a nest with two eggs after incubating for about 21 days. He also describes the behavior of both the male and the female after the end of the normal incubation period.

I previously reported the hatching of twins from two eggs (in different nests in 1949) of the American Goldfinch (Berger, 1953c). In a third instance of twins, the first of five eggs was laid in nest 2-1954 on 19 July. Four of the eggs hatched on 4 August. The nest contained six nestlings when I next visited it.

Walkinshaw (1938-1939) reports a nestling period varying from 11 to 15 days and averaging 12.88 days for 25 young. Stokes (1950) gives a variation from 10 to 16 days for the nestling period, with a mean of 12.3 days for 40 nests; he lists nine nests in which the young fledged at 10 days of age.

I found the nestling period to vary from 11 to 17 days, with an average of 13 to 15 days. I feel that young goldfinches rarely leave the nest before they are 12 days of age *if they are undisturbed*. The oldest birds in the brood are capable of a strong and sustained flight of 50 or more yards when they are ready to leave the nest. As is true of other passerine species, of course, the young will leave the nest prematurely if they are disturbed during the nestling period (e.g. by being weighed or banded, or by a predator). The birds then may simply flutter to the ground below or near the nest, or they may fledge earlier than if they had not been disturbed by handling. In a brood of five or more young, the young may hatch over a 3-day period. The evidence suggests that the youngest bird in a brood many times leaves the nest at a younger age than its older siblings. Even in such instances I feel that a nestling period of 10 or 11 days is most unusual.

The number of young fledged from my nests varied from one to six. Six young were fledged from at least 20 of the nests containing 6-egg clutches. Moreover, nest 2-1954, in which six young hatched from five eggs, fledged six young. The single nest I found with seven eggs fledged six young. Sutton (1959b) found one nest containing seven large nestlings, which probably fledged successfully.

Stokes (1950) reported that "Approximately 15% of Goldfinches start a second brood between August 5 and September 1." He found seven females that raised second broods. I did not chance to find second nests for any of my banded females but I did observe copulation between two different pairs a few days before their young left the nest. Copulation occurred at nest 3-1947 on 21 August, two days before three young left the nest. Three days before their young left nest 4-1949, the male mounted the female while she was perched on a telephone wire near the nest. The male dismounted, the female spread and fluttered her wings, and then mounted the male (reverse mounting). Copulation took place on a telephone wire above nest 5-1947 on 29 August, two days before the first egg was laid in this nest. The male fed the female after he dismounted following copulation.

The exact cause of nest destruction, either with eggs or young, is rarely known. Stokes (1950) remarks that "Storms were the only definite cause for nest failure,

but Deer Mice, Garter Snakes, and death of the female were probable factors." Nickell (1951) calls attention to the secondary uses of goldfinch nests by white-footed deer mice (*Peromyscus leucopus*). The mice remodel the nest by arching the lining upward to form a roof over the nest cup. In addition to numerous examples of this use of abandoned goldfinch nests by *Peromyscus*, I found four goldfinch nests that probably were usurped by the mice while the nests were active. In another instance I found a mouse in a remodelled nest three days after four young had fledged. I found a garter snake (*Thamnophis*) coiled in an empty goldfinch nest which had held five eggs 10 days earlier, but I was unsuccessful in capturing the snake in order to examine it. Walkinshaw (1943) reports finding a blue racer (*Coluber constrictor flaviventris*) that had eaten a young goldfinch in Michigan.

Walkinshaw, Nickell, and others have called attention to the compact structure of goldfinch nests, noting that the nests will hold water for some time. I have observed several nests containing incomplete clutches of eggs with water in the nests. Nickell commented that he had never found young birds drowned in nests containing water, nor have I observed this situation. It seems probable that nestlings small enough to drown because of water in the nests would be brooded by the female during rain storms. I have inconclusive evidence suggesting that the death of a few nestlings might have been caused by excessive heat in exposed nests.

Two nestlings apparently died because they were impaled by thorns projecting downward toward the nest. One of these fully feathered dead nestlings was impaled through the right wing and had a second thorn sticking into its back.

On a number of occasions I found nestling goldfinches whose upper eyelids were so swollen that they projected downward over the entire eyeball, thus making vision impossible. The bulbous eyelids were yellow or yellowish-white, suggesting a pus-like content. Whether or not this infection ever lead to the death of a nestling I was not sure. In one nestling the yellow color of the right eyelid had disappeared in a 5-day period, the swelling had subsided, and the eye was about half open.

Nickell (1951) states that "late nesting birds which use hawthorns or the dogwoods sometimes find themselves without cover when the leaves of these species drop in the early fall." He found five active nests in leafless shrubs; four of these nests fledged young.

I found 16 active nests which were completely exposed because all, or nearly all, of the leaves had fallen from the *Crataegus* nest bushes. This leafless condition was found for three August nests: 24, 26, and 30 August. September dates by which the leaves had fallen from *Crataegus* containing active goldfinch nests varied from 3 to 19 September.

At least nine of the 16 exposed nests fledged young, and many other exposed nests undoubtedly are successful. My field work extended into the last week of September or later in 10 years. In each of these years, I observed nestling goldfinches during the fourth week of September: the latest young were seen from 25 to 30 September in different years. One nest still held three feathered young on 1 October 1955. Other nests, whose young would have fledged during the first week of October, were destroyed before that date. The female of nest 27-1959, for example, was still incubating four eggs on 17 September; the nest was destroyed before my next visit on 30 September.

Nickell (1951) reports five instances in which young goldfinches apparently were abandoned in the nest and, consequently, died. I found two similar instances. Nest 24-1948 held one nestling too small to band on 11 September 1948; the nestling was dead and the nest had been deserted before 16 September. I banded two nestlings,

whose feathers were just beginning to unsheathe, on 22 September 1955; a third dead nestling, about the same size and with no visible injuries, was also in the nest at that time. On 1 October the two banded young, with feathers unsheathed about  $\frac{1}{4}$  inch, were dead, and the nest had been deserted.

During the years 1947–1957, inclusive, I banded 1,148 American Goldfinches, 1,133 of which were nestlings or recently fledged young. Recoveries were obtained for four nestlings and one adult.

One nestling I banded on 21 August 1948 was found dead on the road by H. B. Tordoff on 4 October 1948, about one mile from the nest. Another nestling I banded on 29 August 1955 was found dead by L. Wandel on 25 September 1955, about three miles from the site of banding. A third nestling I banded on 18 August 1957 was found dead at Alexander, New York, on 8 June 1959 by Mabel Hilken. I color-banded a nestling on 14 August 1948; I saw this bird (an adult male) on 4 June 1949, less than a mile from the site of banding.

I color-banded an adult male and an adult female at their nest with four nestlings on 24 August 1949. On 20 April 1950, I found the colored and aluminum bands on the tarsometatarsus of the female in a Screech Owl (*Otus asio*) pellet (Berger, 1953a).

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