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### **Egg-turning by Northern Cardinal Prior to Onset of Incubation**

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In mid-July 1983, a pair of Northern Cardinals (*Cardinalis cardinalis*) began visiting the *Pieris japonica* beside my house, which is 4.5 miles N of Zebulon, Wake County, N.C. On 28 July, I discovered a nest foundation consisting of a few dried pine needles. The location of the bush, about 3 m

from the window beside my kitchen table, enabled me to watch the nest at frequent intervals throughout each day without disturbing the cardinals.

By 0830 h EDT on 29 July, a cup was taking shape; it was completed, but still unlined, when the female ceased building for the day at 1332 h. During the period from 1248 to 1332 h, the female arrived at the nest with building materials every 1 to 10 minutes. She gathered materials from an area across the driveway, about 20 m from the nest. At 1328 h a hatching-year bird followed her across the driveway. At 1332 h the adult female followed the male across the driveway, and the family party moved out of sight. The female did not roost on the nest that night.

On 30 July, the nest cup was well lined by 0725 h, the time of my first examination on that date. The female was not seen in the vicinity of the nest until 1123 h, when she may have added a bit of lining.

At 0900 h on 31 July, the nest contained one egg. Without removing it from the nest, I marked the egg longitudinally on the upper side with a Roman numeral I. At 1545 h the egg remained in its original position in the nest cup, but it had been rotated 180° so the mark was on the bottom rather than the top. The female did not roost on the nest the night after she laid the first egg.

At 0755 on 1 August, a second egg (marked II) was in the nest. The first egg was now positioned with the mark (I) facing the wall of the nest at the point nearest the egg. The female was not observed on, or in the vicinity of, the nest during the day, and she did not roost on the nest the night after she laid the second egg.

There were only two eggs in the nest at 0619 h on 2 August, and the female was not in attendance. At 0722 she was in the bush beside the nest, which still contained only two eggs. At 0723 h she was sitting on the nest, and she remained there until I flushed her at 0747 h to confirm the laying of the third egg. She remained near the nest while I marked the new egg with an X. Subsequent visits to the nest indicated that the three eggs were turned at least once daily, following the commencement of regular incubation, but each remained in its original position relative to the nest structure and relative to the other two eggs. A fourth egg was not laid. Judging by the female's association with a hatching-year bird and by the date of laying, the clutch was at least her second of the season. On 6 August the nest was empty, but the structure was still intact.

No doubt some movement of the first egg occurs accidentally as the female positions additional eggs in the nest. However, the 180° rotation of the lone cardinal egg during the first few hours after it was laid strongly suggests that the female returned to the nest prior to the laying of the second egg and turned the first one. If she incubated the egg at that time, she did not remain on the nest long enough to be detected by my frequent observations some of them prolonged, scattered throughout the day. The same applies to all her other daytime visits to the nest prior to the laying of the third egg.

Although many references in the general literature indicate that the female pays no attention to the nest and the nesting site between layings, that misconception has been soundly disproved for nearly all passerines that have been well studied. Many species defend nests holding incomplete clutches (pers. obs.), and ornithologists are becoming increasingly aware of the considerable amount of brooding that takes place prior to onset of regular incubation. Regarding the Northern Cardinal, Hervey Brackbill (in Bent, 1968) reports: "Observations on two nests in Baltimore indicate that, although some sitting is done earlier, incubation at full intensity is not begun until the final egg has been laid. At an early May nest there was some incubation on the day the first egg was laid, but the bird did not roost on the nest until the second had been laid, and apparently did not begin steady sitting until the third was laid."

Nolan (1978:200) found Prairie Warblers (*Dendroica discolor*) on the nest from 0 to 16% of the time on the first day of laying, from 0 to 40% on the second day, and from 10 to 43% on the third day; but he did not mention any evidence of egg-turning prior to onset of regular incubation. Tending eggs during the daytime prior to onset of nighttime sitting has also been recorded in the Dusky Flycatcher (*Empidonax oberholseri*) by Morton and Pereyra (1985).

Roosting on the nest and some degree of nocturnal incubation have been noted in several species, including Traill's Flycatcher (*Empidonax traillii*; King, 1955), Acadian Flycatcher (*Empidonax virescens*; Mumford, 1964), Western Flycatcher (*Empidonax difficilis*; Davis, Fidler and Davis, 1963), Eastern Phoebe (*Sayornis phoebe*; Mueller, Mueller and Meyer, 1982), and Blue Tit (*Parus caeruleus*; Haftorn and Reinertsen, 1985).

Morton and Pereyra (1985) noted that sitting on the nest in the daytime prior to completion of the clutch does not maintain the eggs for long periods at temperatures necessary for embryonic growth. Therefore, they suggested that laying-period attentiveness protects eggs from overheating caused by solar radiation when the vegetative canopy may not be fully developed. Haftorn (1978) suggested that nighttime attentiveness during the laying period might protect embryos from low temperatures. However, eggs are not always covered when they are exposed to direct, midday sunlight; and they are often left uncovered during cold weather. To the best of my knowledge, no researcher has been able to correlate laying-period attentiveness satisfactorily with any environmental condition.

There are many references in the general literature to the fact that incubating birds turn their eggs after the onset of incubation. Drent (1973:263) expressed the opinion that counteracting temperature gradients existing in the nest cannot be the only function of egg-turning. He noted that egg movement appears to be critical during the first half of the incubation period and that this behavior apparently reduces the "incidence of premature adhesions involving the extraembryonic membranes." Such adhesions can disrupt the uptake of the egg white and cause other difficulties that may prevent successful hatching. Nonetheless, some birds

(e.g. those that bury their eggs) manage to hatch their young successfully without benefit of egg-turning.

Drent (1973) did not mention the occurrence of, or the need for, egg-turning prior to onset of regular incubation. However, my report of such behavior should not be surprising in view of the abundant evidence of sitting on eggs during the laying period. Future studies may reveal that egg-turning is a routine activity from the very first day of laying.

The more we learn from studies of avian behavior, the more we realize that all birds of a given species are not destined to do everything exactly the same way. For example, Conner, Anderson and Dickson (1986) reported that song complexity in the Northern Cardinal is negatively related to fledging success. Compared with experienced males, they suggested, young male cardinals "may use longer, highly complex songs when first establishing a territory. In subsequent breeding seasons, age or prior ownership of a particular territory may permit the male to put 'less effort' into song (complexity) and allow more effort for nest defense and care of young." Is it possible that the experienced female turns her eggs and slips quickly away, whereas the inexperienced female spends quite a bit of time at the nest when she turns her eggs? Is it possible that sitting on the eggs without effectively incubating them stimulates development of the brood patch or in some other way prepares the inexperienced female for regular incubation?

All matters related to care of eggs during the laying period are poorly documented and poorly understood. Future studies of the nesting cycle should attempt to document egg-turning and brooding prior to onset of regular incubation and correlate those activities with the age (nesting experience) of the bird.

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## First Record of a Pacific Loon from North Carolina

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On 15 May 1987, John Fussell, Keith Archibald, Larry Crawford and I observed a small loon swimming near a Common Loon (*Gavia immer*), both about 100 m off Cape Hatteras Point, near Buxton, Dare County, N.C. After examination through a 50 X Questar, I identified the bird as a "black-throated" type loon (either Arctic Loon, *G. arctica* or Pacific Loon, *G. pacifica*). We studied the bird through a variety of scopes from 1045 h to 1115 h when we were joined by Ricky Davis, Harry LeGrand and Mark Oberle. All seven of us watched the loon until 1245 h when it took off, circled once and flew away to the north.

Compared with several Common Loons in the vicinity, the bird was notably smaller, the head was more rounded and it had a smaller, more dagger-like bill which was straight (Fig. 1). The bird was molting into breeding plumage. The nape and rear half of the crown were pale blond grading to much darker on the cheek and sides of the neck (Fig. 2). The sides of the neck from the level of the malar area to the waterline were finely striped in black and white. The chin and foreneck were entirely white except for a narrow chinstrap of brownish feathers. The scapulars were blackish with several rows of square, white spots. The flanks were uniformly dark to the waterline.