Method for determining the incubation stage of Pied Flycatcher *Ficedula hypoleuca* eggs

Mikko Ojanen & Markku Orell

Ojanen, M. & M. Orell 1978: *Method for determining the incubation stage of Pied Flycatcher* Ficedula hypoleuca *eggs.* — Ornis Fennica 55: 29—31.

The diameter of the air bubble in the blunt end of the egg can be used to decide whether a clutch of the Pied Flycatcher has been completed. A newly laid egg has no air bubble. On the first day the diameter of the air bubble of an unincubated egg does not exceed 5 mm; after 4—5 days' incubation it measures 9 mm, and after 9 days' incubation ca. 10 mm. The last and often also the penultimate egg are paler than the others. Changes in the colour pattern of the egg during incubation also make it possible to determine whether incubation has started. This method (or its modifications) is also valid for *Phoenicurus phoenicurus, Parus major* and *Columba palumbus,* and fairly good to *Sturnus vulgaris.*

Mikko Ojanen, Department of Anatomy, University of Oulu, SF-90100 Oulu 10, Finland

Markku Orell, Department of Zoology, University of Oulu, SF-90100 Oulu 10, Finland

The incubation stage of bird eggs can be judged by immersing them in water and inspecting their buoyancy, or by using the so-called candling method (Weller 1955). These methods have been used in estimating the laying date of the clutch and also to discover whether the clutch has been completed (Westerskov 1950, Barth 1952, Weller 1955, Väisänen 1969). But as far as we know, they have not been employed by ornithologists working with Passerines. In this paper we present a method suitable for determining the laying sequence and the laying date of the eggs of a number of Passerines.

Determining the incubation stage

Data were collected in 1970—74 from about 40 nests of the Pied Flycatcher *Ficedula hypoleuca.* Nests were inspected daily and new eggs were marked with dots of Indian ink. The breadth and length of the eggs, and the breadth of the air bubble in the blunt end of the egg were measured with a sliding caliper with a dial.

Fresh, newly laid eggs have no air bubble. As the female lays her eggs at 5—6 a.m. (our own observations), such eggs can be found up to 10 a.m. Later on, a small air bubble can be observed, which enlarges as water evaporates through the pores of the eggshell. In an egg which has not been incubated the approximate diameter of the bubble is 4.7 mm on the first day, 5.8 mm on the second day and 6.0 mm on the third day (Fig. 1.).

The diameter is influenced by the

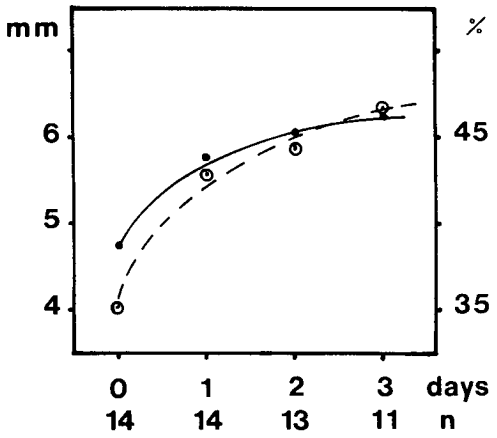

FIG. 1. Diameter of the air bubble in the egg of the Pied Flycatcher during the laying period (solid line = diameter in mm, dotted line = diameter as % of egg breadth, n = number of eggs measured).

size and shape of the egg, by air temperature and also by the degree of porosity of the eggshell. The size of the air bubble varies much less within the clutch than between clutches, and can thus be used to determine the laying order of the three latest eggs in a fresh clutch. If the smallest diameter of the bubble in a clutch is 4—5 mm, the eggs are newly laid and, even when warm, the clutch is not necessarily completed.

The last egg in a clutch can be distinguished by the small size of the air bubble, but it also has a lighter colour than the other eggs. We have not found any exceptions to this rule in about 200 clutches in which the last egg was known. The penultimate egg is also often paler than the others, but darker than the last. Likewise in *Troglodytes aedon* (KENDEIGH et al. 1956), the last eggs are paler than the others.

During incubation, the bubble increases to 9 mm in diameter within 4—5 days (Fig. 2.), which is about 70 % of the egg breadth. After 9 days' incubation the bubble is about 10 mm in diameter and ceases to enlarge.

The colour of the egg is also affected by incubation. Fresh eggs are bright and transparent. After 3 days' incubation, dim structures can be seen in the yolk region, which are caused by the developing membrane system of the embryo. In eggs incubated for 4—5 days, the embryo and the beating heart can be seen through the shell, if the egg is inspected from a suitable angle in bright sunshine (WELLER 1955).

After 7 days' incubation, the inside of the egg is entirely covered by opaque membrane (allantochorion). A dark ring then begins to appear just under the air bubble. At this time the last remnants of egg white can be seen in the sharp end of the egg, outside the cover of allantochorion (Fig. 3). The dark ring may be up to 3—4 mm wide in eggs incubated for 10 days, but this feature varies greatly. A new, lighter ring may sometimes appear above the dark ring during the last days of incubation. Slightly before hatching a part of the dark ring may disappear (Fig. 3) at the place where the beak protrudes. This description of the rings is idealized, for deviations from the above pattern are common.

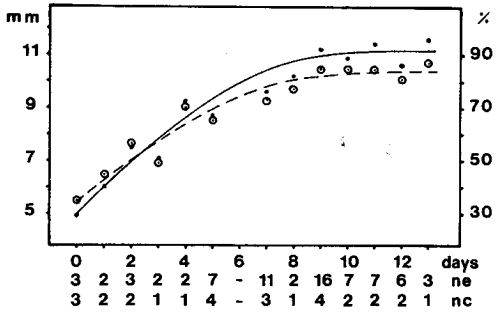

FIG. 2. Increase of the diameter of the air bubble in the egg of the Pied Flycatcher during incubation (solid and dotted lines as in Fig. 1., ne = number of eggs measured, nc = number of clutches studied).

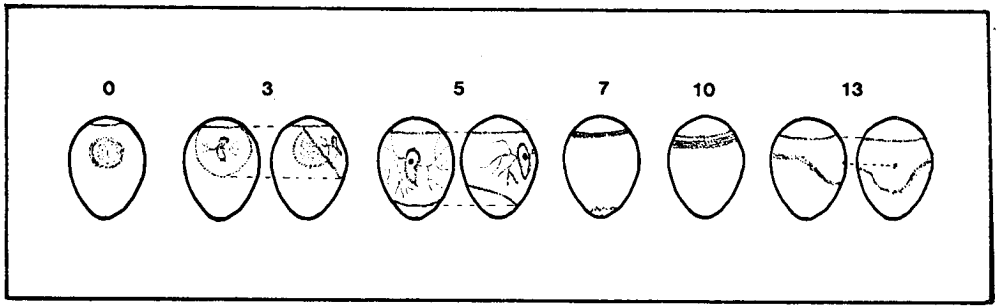

FIG. 3. Changes seen the egg during incubation. Stages between 0—7 days distinguished by viewing the eggs against the sun, later stages by examining the appearance of the egg.

Thus, the laying date of the clutch can be estimated reliably from the size of the air bubble and the colour of the eggs.

Suitability of the method for other species

We have used the above method successfully for the Redstart *Phoenicurus phoenicurus*, too. For the Starling *Sturnus vulgaris*, whose eggshell is rather thick, the method is not always suitable. The eggs of tits *(Parus)* are dotted at the blunt end, which decreases transparency, and we have therefore used changes in egg brightness to describe incubation stages. Four grades were distinguished: bright, yellowish, light-grey and dark-grey, which correspond to the following incubation stages: fresh, 3—4 days, 7—11 days and 11—14 days. The eggs of the Wood Pigeon *Columba palumbus* are also so transparent that the air bubble and the beating heart can easily be seen during the early stages of incubation.

Selostus: **Kirjosiepon munien haudonta-asteen määrittämismenetelmä**

Kirjosiepon munan tylpempään päähän ilmestyy ilmakupla pian munimisen jälkeen, ja tämä kasvaa hautomattomassa (kuva 1) ja edelleen haudotussa munassa (kuva 2). Ilmakuplan koon perusteella voidaan arvioida muninnan alkaminen (kuva 2). Viimeinen ja usein myös viimeistäedellinen muna ovat muita vaaleampia. Myös haudonnan aikana tapahtuvaa munien värin muutosta (kehittyvä sikiö "tummentaa" asteettain munan yleisväritystä) voidaan käyttää arvioitaessa, kuinka kauan pesyettä on haudottu. Menetelmä sopii leppälinnulle, sepelkyyhkylle ja varsin hyvin myös kottaraiselle. Talitiaisen munan hautomisastetta voi arvioida munan läpikuultavuuden muutosten perusteella: kirkas, kellertävä, vaalean harmaa ja tummanharmaa vastaavat tuoretta, 3—4 päivää, 7—11 päivää ja 11—14 päivää haudottua munaa.

References

BARTH, E. K. 1952: Incubation period and the loss of weight of eggs of the Common Gull, Larus canus canus, and of the Lesser Black-backed Gull, L. fuscus intermedius. — Pap. Game Res. 8:111—121.

KENDEIGH, S. C., T. C. KRAMER & F. HAMERSTRÖM 1956: Variations in characteristics of the House Wren. — Auk 73:42—65.

VÄISÄNEN, R. A. 1969: Evoution of the Ringed Plover (Charadrius hiaticula L.) during the last hundred years in Europe. A new computer method based on egg dimensions. — Ann. Acad. Sci. Fennicae A IV Biol. 149:1—90.

WELLER, M. W. 1955: A simple field candler for waterfowl eggs. — J. Wildl. Mgmt. 19: 111—113.

WESTERSKOW, K. 1950: Method for determining the age of game bird eggs. — J. Wildl. Mgmt. 14:56—67.

Received November 1977, revised January 1978