Estimating the date of hatching of eggs of Golden Plover *Pluvialis apricaria*

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Introduction

Because they are nidifugous, wader chicks are usually ringed in the nest within a day of hatching. It is useful, therefore, to be able to predict the date of hatching of a nest found at some unknown date through incubation. We have found enough nests of Golden Plover *Pluvialis apricaria* in the last three years, and followed them though to hatching, to allow a reasonable prediction of hatching date to be made.

Methods

All nests (24) were found in the Peak District, in northern England, between 1986 and 1988. On discovery of a nest, length and breadth of each egg was measured to 0.01 mm using Camlab plastic calipers, and weighed to 0.1 g with a 50 g Pesola balance. A Volume Index ($L \times B^2 \div 1000$, as per Byrkjedal & Kålås 1985) was calculated for each egg, and there mean weight and Volume Index for each clutch then calculated. These means were used to calculate a Density Index (Weight $\div$ Volume Index). Most nests (21) were followed through to hatching, and the date of which the measurements had been taken was then expressed as the number of days before hatching.

A few clutches were reweighed later in incubation, and these allow a direct estimate of the rate of loss of weight. The regression of 'Density Index' on 'Date of Hatching' was calculated but without using these re-weighings, because both the date to hatching and the weight (as taken under field conditions) were subject to error and approximation, the regression used was the reduced major axis.

Results

Egg dimensions and densities are summarised in Table 1. Density indices were calculated for 21 clutches which were followed through to hatching. The regression is shown in Fig. 1, together with the calculated values for day –30 (the start of incubation: Nethersole-Thompson & Nethersole-Thompson 1986) and day –1 (by which time the eggs are chipping, making calculation of hatching date superfluous). The calculated regression is $y = 389x + 168$ ($r = 0.86$, $p < 0.001$) where y = date before hatching and x = density index. Golden Plover eggs at the start of incubation should have a relative density of 0.509. By day –1 this has reduced to 0.434 (if chipping has not reduced it further).

The absolute loss rates varied between 0.095 and 0.19 g/day, or between approximately 0.3 and 0.6% of egg weight per day. Averages, from eight determinations, were 0.15 g/day (S.D. 0.036) and 0.47% per day (S.D. 0.17). Thus over 30 days of incubation, a Golden Plover egg loses an average of 4.5 g, or 14.0% of its initial weight. These values are close to the loss rate of 0.17 g/day calculated from the regression equation.

Discussion

Rahn & Ar (1974) argued that weight loss of eggs during incubation was entirely due to loss of water. They further suggested that the proportion of the weight loss might be relatively constant across a taxonomically wide range of birds at around 18%. The figure of 14% is low by this standard. One interesting detail of our study is that in one clutch
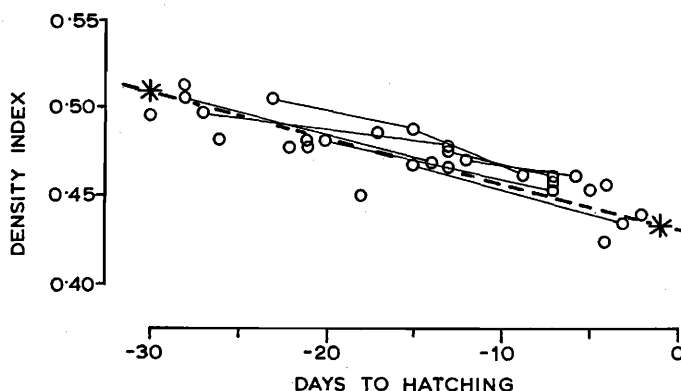

Figure 1. Density index (Weight/Volume Index) for 21 clutches of Golden Plover *Pluvialis apricaria* eggs in relation to date to hatching. The asterisks indicate calculated values for days –30 and –1 and the heavy dashed line is the calculated regression y = 389x + 168. Thin lines join values for clutches that were re-weighed during incubation.

Table 1. Egg dimensions of 24 clutches of Golden Plover *Pluvialis apricaria*: Length (L), Breadth (B) and Volume Index (VI), and calculated initial density, initial weight and weight loss from the regression (y = 389x + 168). Note that the Volume Index of 64.78, calculated from the mean Length and mean Breadth is slightly lower than the value given here, which is the mean value for the Volume Index of each clutch.

Mean (S.D.)			Calculated		
L (mm)	B (mm)	VI	Initial density	Initial weight (g)	Weight loss (g/day)
50.43 (1.56)	35.84 (1.02)	64.95 (4.73)	0.509	33.06 (2.41)	0.17

where three of four eggs were later found to be dead, the three dead eggs lost weight at the same rate as the live egg. This suggests that water loss is a passive progress, dependent on average temperature and relative humidity but not affected by the metabolism of the developing embryo. If this reasoning is correct, it suggests that the low rate of water loss of our Golden Plover eggs might be related to the relatively humid nesting habitat: all these nests were in blanket bog vegetation over deep peat. It is further possible that the considerable variation between clutches might be related to difference humidity around each nest.

To return to the main point of this note, it is certainly possible to estimate, from relative egg density, whether the clutch is in its first, second or third 10-day period of incubation. However, the method is not sufficiently accurate to allow the exact date or hatching to be predicted, and visits every two to three days would still be necessary once the relative density falls below 0.45. Reweighing the eggs at least once during incubation, to get an estimate of the rate of weight loss for that particular clutch, does allow more precision.

Lastly, of course, the fresh egg weight can be calculated from the relationship: Volume Index × 0.509. The mean volume index of 24 clutches was 64.95 (S.D. 4.73), and the mean weight of a newly laid egg is therefore estimated to be 33.06 g (S.D. 2.41 g).

Acknowledgement

References

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Growth of Common Sandpiper chicks

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Common Sandpipers grow from 8.70 g at hatching to 40.11 g at fledging, at a rate of 1.65 g day^{-1}, and their bills lengthen from 9.20 mm to 20.83 mm over the same period, a rate of 0.61 mm day^{-1}. Growth in mass in probably sigmoidal, and bill length is a better criterion for ageing very young and nearly fledged chicks. In the middle range, bill lengths and mass are closely correlated, so allowing the use of relative mass to judge a chick's condition.

Introduction

In a previous paper (Holland *et al.* 1982), we suggested that chicks of Common Sandpiper *Actitis hypoleucos* grow from 8 g at hatching to about 40 g at fledging, 19 days later. We have not, however, published any details of growth rates, and are not aware of any other such publications on Common Sandpipers. This paper summarises the information available to use after 12 seasons of fieldwork.

Material and method

Common Sandpiper chicks are difficult to find except as newly hatched young in or near the nest. Once fully mobile they are adept at hiding in such places as burrows and under boulders. When first fledged, however, they are vulnerable to capture in mist nets set across the breeding streams. Thus we have most information for very young and just-fledged chicks. Chicks were weighed (to the nearest 0.1 g when very