NOTES ON THE INCUBATION OF THE EGGS OF THE GRASS SNAKE, *NATRIX NATRIX NATRIX*

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INTRODUCTION

The methods employed by herpetologists to artificially incubate reptile eggs are numerous, and many of these appear to be successful. In addition to a variety of incubation mediums there is often a diverse approach to the thermal and moisture levels of the incubation medium. During incubation there are many reports of changes in the dimensions and the masses of the eggs (see Packard et. al., 1977, for review). Few of these data however have been quantified. This paper reports on a method used to incubate a clutch of grass snake *(Natrix natrix natrix)* eggs based on a regime of fluctuating temperatures. Information is given on the results of this method and also of the changes in mass and dimensions of the eggs as incubation proceeded.

METHOD

On the September 23rd 1980 a clutch of ten eggs were deposited by a newly imported female Italian grass snake *Natrix natrix natrix.* These eggs ranged in length from 25-30mm, in width from 16-18mm and in mass from 5.2-6 grammes. The eggs were incubated in vermiculite to which water was added. The ratio of water to vermiculite was in the region of five parts water to one part vermiculite (in weight). The eggs were sunk into the medium until they were approximately two thirds buried. The container was heated by an incandescant light bulb which was turned on around 0700 hrs each morning until around 2300 hrs each evening. This produced fluctuations in temperature (Fig. 1). Throughout incubation records were taken of the changes in length, width and masses of the eggs at 10, 20, 30 and 40 day intervals. Length and width were straight line measurements across the eggs. Egg mass was determined by triple balance scales.

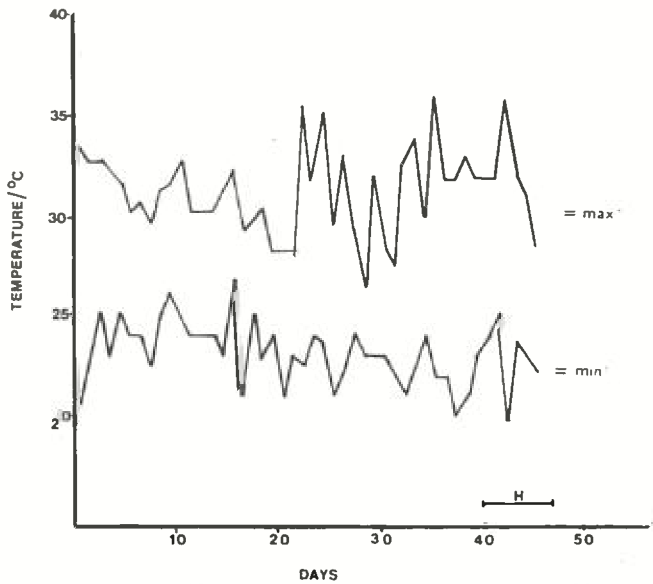

Fig 1. A graph showing the maximum and minimum temperatures recorded to incubate *N. natrix* eggs. Throughout incubation a maximum temperature of 36°C and a minimum temperature of 20°C was recorded. The mean temperature based on all temperature records was 27.1°C (n = 90). The hatching period (H) is shown at the lower end of the graph.

RESULTS

During incubation three of the eggs showed signs of collapse. On opening these no sign of embryonic development could be found. Hatching in the remaining eggs began after 40 days; the last egg hatched after 46 days. Complete emergence by the young snakes took place 18-48 hours after first splitting of the shell casings. On inspection one of the young grass snakes was found to have a deformity of the spinal column.

Throughout incubation changes in length, width and mass were observed. Final lengths just previous to hatching were from 29-33mm, widths from 23-27mm and masses from 14-18 grammes. The changes in dimensions and mass are highly correlated (length v. mass, $r = 0.87$, $P < 0.001$: width v. mass $r = 0.93$ $P < 0.001$). Growth between these variables can be described by the equation $y = b + m \log X$. Where the egg length or width (y) in mm is related to the logarithm (loge) of the mass x in grammes by the y intercept b and the slope m. This gives for egg length,

$$y = 16.9 + 5.2 \log x \qquad (1)$$

for egg width,

$$y = 4.09 + 7.64 \log x \qquad (2)$$

It is interesting to note that a slightly higher correlation has been found between egg width and mass. Figure 2 shows the data plotted on semi-logarithmic coordinates with lines taken through the data predicted by the constants in these equations. The data are based on 5 successive measurements on the 7 eggs which reached full term (i.e. $n = 35$).

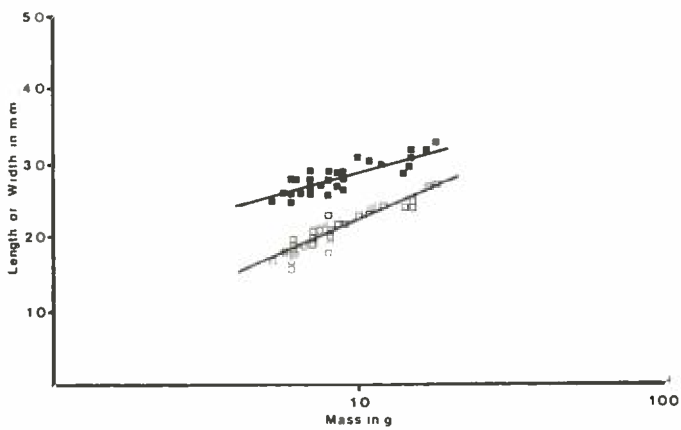

Fig. 2. A graph on semi-logarithmic coordinates of egg mass plotted against egg length (■) and egg width (□). The lines taken through the data are based on equations (1) and (2) in the text.

Three dimensional growth can be described after transforming the data to logarithms and by the multiple regression,

$$y = o\ x\ \beta_1 m \beta_2$$

where the mass (y) in grammes is related to the egg length (x) and egg width (m) in mm by the constants o, β_1 and β_2; 95% levels of significance have been attached to β_1 and β_2 using the t distribution (Bailey 1959). Thus,

$$y = 0.00054\ x\ 1.31 \pm 0.6 m\ 1.75 \pm 0.32\ (r^2 = 0.88,\ n = 35) \qquad (3)$$

This equation has a slightly higher correlation than equations (1) and (2); i.e. $r = \sqrt{r^2} = 0.94$.

Changes in egg mass are also time dependant. This can be estimated from the quadratic equation,

$$y = 6.273 - 0.062\ X + 0.007\ X^2\ (r^2 = 0.93) \qquad (4)$$

Where the egg mass y in grammes is determined from the incubation period x in days. Figure 3 is a graph showing these time dependant changes in mass for *Natrix* eggs with a line taken through the data predicted by the constants in this equation.

After a period of 4 weeks during which the young snakes would accept no food they were placed in a small container and subjected to a winter cool period. On April 10th 1981 they were housed in a heated vivarium and offered small *Xenopus laevis* and their larvae which they eagerly accepted.

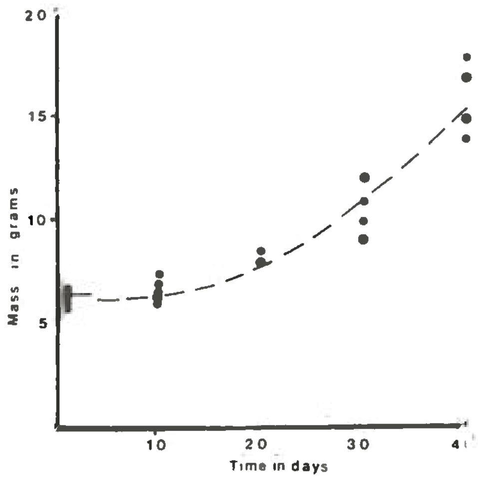

Fig. 3. A graph showing time dependant changes in mass of grass snake eggs. The large circles represent more than one data point. The line taken through the data is based on equation (4) in the text.

DISCUSSION

According to Smith (1973) Rollinat recorded a 42 day incubation period for *Natrix* eggs at 20-26°C. This is in approximate agreement with Riches (1976) who states that at 27-29.5°C incubation should take from 40-46 days, but it is marginally longer than a clutch incubated by Swailes (1979). Although it would appear that persistant high or low temperatures are to be avoided (Swailes, 1979; Riches, 1976), the fluctuating temperature regime described in this paper resulted in a normal incubation term of 40-46 days. The growth recorded for these eggs might therefore also be regarded as typical and the mathematical models obtained from the data a useful tool in determining the egg masses at successive stages during incubation. A quantative comparison of growth of the eggs of the lizard *Basiliscus basiliscus* has been described in tabulated form by Claesson (1979) and it is interesting to note that equation (3) agrees well with these data.

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