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NOTE ON VARIABLE INCUBATION PERIOD WITHIN A CLUTCH OF EGGS OF THE LEOPARD TORTOISE (GEOCHELONE PARDALIS) (CHELONIA: CRYPTODIRA: TESTUDINIDAE)

B. L. CAIRNCROSS* AND J. C. GREIG†

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Jayakar & Spurway (1964) reported on a case of apparent bimodality in laying-hatching time in *Geochelone* (*Geochelone*) *elegans*, the Indian starred tortoise. Two peaks of hatching within a clutch of seven eggs were noted, one after *c.* 50 days and one after *c.* 130 days. The suggestion was made that, as all eggs were kept under identical conditions, and as a distinct tendency towards bimodality was observed in the incubation period, the mechanism of delay is not simply determined by environmental factors, but is also influenced genetically.

A similar case was reported for *Geochelone* (*Geochelone*) *sulcata* in the Sudan by Cloudsley-Thompson (1970) where one egg out of a clutch of 17 hatched on 16 June 1966 after incubating for 212 days. As no more hatched, two of the remaining eggs were opened on 6 August for inspection; one of these was dead but the other contained a living embryo of length 37 mm (cf. hatchling length of 45 mm). No further eggs hatched, but on the evidence afforded by this observation, Cloudsley-Thompson suggested that the hatching period within a single batch of eggs may extend over several months in *G. sulcata*.

One of us (B.L.C.) has kept many tortoises of several South African species in captivity since 1930, one of these being *Geochelone* (*Geochelone*) *pardalis*, which is widely distributed from the Cape to the Sudan. It is a close relative of *G. sulcata* and *G. elegans*, and shares with these other members of the same subgenus, both large size and the capacity to lay large clutches of eggs. Various attempts were made to hatch eggs of this species in an incubator (Cairncross 1946) but the great majority were infertile. However, a clutch of 12 eggs laid in Pretoria, South Africa, by a specimen of *G. pardalis* originating from the farm "Waterkloof" near Aberdeen (map reference: 3224AC Aberdeen: 32° 18′S/24° 06′E) included two fertile eggs. The clutch was laid on 19 December 1945 and the nest was marked and watched. On 30 March 1947 a small hole was observed above the nest after rain, and a newly hatched, active, mud-covered tortoise was found about 3 m away. The site was watched for further activity until 27 April, but as no further hatchings occurred, the nest was opened and the eggs were removed. A broken empty shell was found, as expected, together with the remaining 11 whole eggs. The eggs were opened, and although ten had putrefied, the 11th contained a living embryo *c.* 6 mm long (cf. hatchling length of 50 mm.)

In sea turtles nesting in south-east Africa the hatching of individuals within a single clutch of eggs is normally synchronized within a

*"Glenderg", Box 188, George 6530.
†Department of Nature and Environmental Conservation, Private Bag 5014, Stellenbosch 7600.

latitude of, at most, two or three days (Hughes 1974 *a*, *b*). It might be expected that the eggs of terrestrial tortoises would show a similar synchrony in hatching, as all experience the same fluctuations in nest micro-climate. However, as this does not necessarily seem to be the case in at least three out of the four species comprising the subgenus *Geochelone*, there may indeed be adaptive significance in the staggering of hatching dates as Jayakar & Spurway (1964) suggested. There is a possibility that rain may trigger emergence of hatchlings in some land tortoises, perhaps because it softens the sun-baked soil, thus facilitating escape from the nest. It could be that the phenomenon of staggered hatching has been selected for in arid climates where one shower of rain does not necessarily signify that ideal conditions will prevail for the survival of newly hatched tortoises. All three species referred to in this communication are found in such climatic situations.

Marine turtle hatchlings on the other hand, which emerge *en masse* from large clutches, may rely on numbers to reduce percentage predation in the very vulnerable first few days after hatching; it may thus be postulated that adaptation in respect of differing incubation periods is of little selective advantage in this case.

The importance of the observation recorded in this short communication was not fully appreciated at the time of occurrence, and more precise figures are thus not available. Nevertheless, we present this data in view of the paucity of breeding information on South African tortoises, and in hopes that this note may serve to stimulate further investigation of the phenomenon.

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