Proc. Indian Acad. Sci. (Anim. Sci.), Volume 91, No. 2, March 1982, pp. 189–197.

Transabdominal migration of ova in some freshwater turtles

P L DUDA and V K GUPTA*
Department of Biosciences, University of Jammu, Jammu 180 001, India
* Present address : Department of Rural Technology, Regional Research Laboratory (CSIR), Jammu 180 001, India

MS received 9 July 1980 ; revised 18 July 1981

Abstract. The phenomenon of transabdominal migration of ova is fairly common in all three fresh water turtles, *Lissemys punctata punctata* (70%), *Kachuga tectum tectum* (4%) and *K. smithi* (73%), studied for the present work. Individuals of *Lissemys punctata punctata*, *Kachuga smithi*, showed higher frequency of ovular migration in smaller individuals. It is suggested that a better weight balance is possibly achieved by ovular migration in these aquatic reptiles.

Keywords. *Lissemys punctata punctata* ; *Kachuga tectum tectum* ; *Kachuga smithi* ; transabdominal ; ovaries ; corpus luteum ; ova ; oviduct ; ovulation.

1. Introduction

Upon rupture each ovarian follicle releases its contained egg into the body cavity which is immediately engulfed by the infundibulum of the oviduct. Eggs ovulated by left ovary normally pass into left oviduct and those of right ovary into right oviduct. The collapsed follicular wall of the ovulated follicle eventually gets transformed into corpus luteum. The number of corpora lutea thus provides a fairly accurate index to the number of eggs produced by an ovary of a side at a given time and also indicates the number of eggs expected in the oviduct of that side. Ordinarily, the total number of corpora lutea in the two ovaries of an animal corresponds to the total number of eggs in the two oviducts, except in instances where either oviposition is extended beyond the resorption of corpus luteum or clutching is multiple. Yet, it has often been observed that the counts of corpora lutea in the ovary of one side and the number of oviducal eggs in the ipsilateral oviduct differs, some times strikingly. This difference is sought to be explained only by the phenomenon of transabdominal migration of eggs during the short period that intervenes between the act of ovulation and encapsulation by the oviduct.

Although reported in mammals too (Asdeil 1946; Arey 1954), the phenomenon of transabdominal migration of eggs in reptiles was for the first time reported by Weekes (1935). Ever since, the phenomenon has been reported for snakes (Tinkle 1957), lizards (Tinkle 1961 : Mayhew 1963, 1965, 1966, 1971 ; Telford 1969; Cuellar 1970; Goldberg 1972) and turtles (Tinkle 1957; Legler 1958; Moll and

Legler 1971; White and Murphy 1973: Plummer 1977; Cox and Marion 1978). To obtain some more information on this very common phenomenon among reptiles and therefore presumably of importance to them, three Indian freshwater turtles, *Lissemys punctata punctata, Kachuga tectum tectum*, and *K. smithi* were intensively studied from the standpoint of ovulation in them from 1976 to 1978.

2. Materials and methods

Specimens were collected by hand, muddling, or by cast nets from two different sources. *Lissemys punctata punctata* were collected from Lake Mansar (about 65 km in the East of Jammu city, India) and *Kachuga tectum tectum* and *K. smithi* were collected from a slow running stream, New Gho-Manasan Khul, situated about 15 km south-west of Jammu city. The taxonomy of the forms studied was done after Smith (1931).

All linear measurements of the specimens were done in the laboratory with the help of 1 meter flexible steel tape from live animals. Measurements were recorded to the nearest millimeter. After preliminary weighing and measurements, the turtles were dissected for examination of ovarian weight; the number and size of ovarian follicles and corpora lutea; the number, size and weight of shelled oviducal eggs, were noted separately for right and left side. The weights were recorded to the nearest milligram.

3. Results and discussion

During their breeding season, which extends from August to October in *Lissemys punctata punctata*, October to February in *Kachuga tectum tectum* and August to November in *K. smithi*, 14 adults of *Lissemys p. punctata* (table 1, figure 1) 30 of *Kachuga t. tectum* (table 2, figure 2) and 17 individuals of *K. smithi* (table 3, figure 3) were found to contain eggs in their oviducts. Of these 4 individuals of *Lissemys p. punctata*, 25 of *Kachuga t. tectum* and 2 of *K. smithi*, showed more corpora lutea than the number of eggs in their oviducts, representing more than one series of ovulation and were thus of varying size and appearance. The remaining individuals showed number of corpora lutea to be equal to the total number of eggs in two oviducts.

Of the remaining 10 turtles of *Lissemys p. punctata*, three showed the number of eggs in one side oviduct to be equal to the number of corpora lutea in the ovary of the same side. However, in the remaining 7, a striking disparity in their number (table 1, figure 1) was observed. Four of these 7 turtles showed more corpora lutea in the right ovary than in the left and three more corpora lutea in the left ovary than in the right. The number of eggs in the oviducts of these seven was equal on two sides in two individuals (5 and 3 in each oviduct), and unequal in 5, being greater in the right oviduct in 2 and in the left oviduct in 3 individuals.

In *Kachuga t. tectum*, only two individuals of the 5 animals (where number of corpora lutea was equal to egg number in the oviducts) showed the phenomenon of ovular migration (table 2, figure 2). The remaining 3 individuals possessed equal number of corpora lutea and oviducal eggs on each side. In these cases it was impossible to determine whether ova had migrated from one side to the

Table 1. Number of corpora lutea, eggs and ovarian weight (g) in *Lissemys p. punctata* on the right and left sides of the body.

Sl. No.	Plastron length (mm)	Right side			Left side			Total number of corpus luteum	Total number of shelled eggs
		Corpus luteum	Shelled eggs	Wt. of ovary	Corpus luteum	Shelled eggs	Wt. of ovary		
1.	250	3	2	29·400	4	5	48·900	7	7
2.	265	7	4	33·800	11	6	61·100	18	10
3.	225	4	3	10·600	6	2	24·250	10	5
4.	286	5	7	19·600	8	6	30·300	13	13
5.	225	1	2	6·700	5	4	6·450	6	6
6.	245	6	4	56·400	5	7	42·900	11	11
7.	267	5	5	32·000	5	5	36·000	10	10
8.	235	3	3	43·100	5	5	21·050	8	8
9.	281	8	7	21·720	4	5	35·800	12	12
10.	244	6	5	42·000	4	5	31·100	10	10
11.	217	4	3	8·200	2	3	7·720	6	6
12.	282	15	8	18·200	10	5	28·100	25	13
13.	258	9	5	27·200	9	4	20·900	18	9
14.	239	4	4	36·900	4	4	48·200	8	8

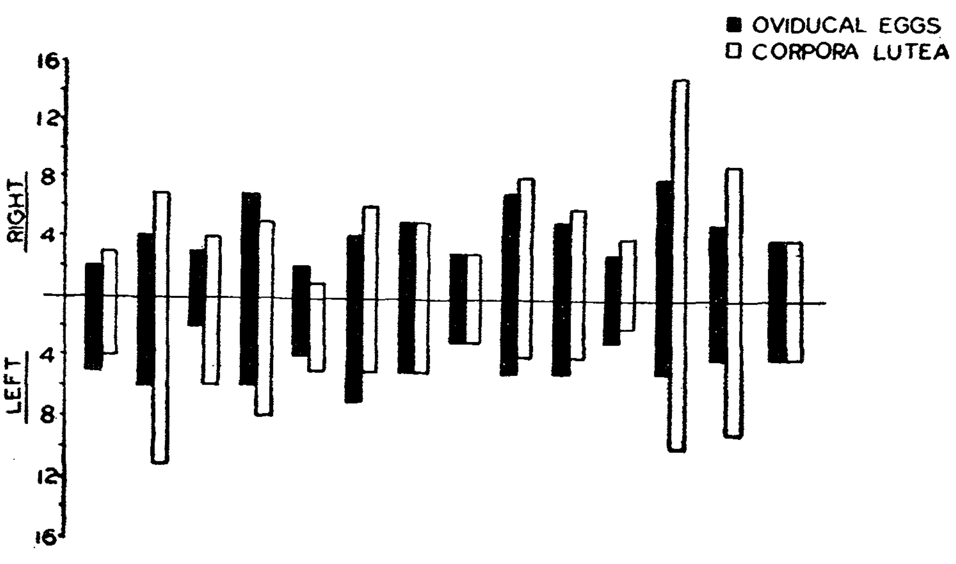

Figure 1. Comparative counts of oviducal eggs and corpora lutea in *Lissemys p. punctata* (represented by black and white bars, repectively).

Table 2. Number of corpora lutea, eggs and ovarian weight (g) in *Kachuga t. tectum* on the right and left side of the body.

Sl. No.	Plastron length (mm)	Right side			Left side			Total number of corpus luteum	Total number of shelled eggs
		Corpus luteum	Shelled eggs	Wt. of ovary	Corpus luteum	Shelled eggs	Wt. of ovary		
1.	170	9	6	12·580	10	4	8·200	19	10
2.	173	3	4	6·600	4	3	19·950	7	7
3.	165	7	3	2·310	5	4	3·425	12	7
4.	166	3	4	3·700	4	3	3·450	7	7
5.	161	5	4	2·900	8	3	2·750	13	7
6.	168	8	4	4·640	14	5	4·150	22	9
7.	160	7	3	2·995	3	3	2·725	10	6
8.	185	3	3	43·200	3	3	26·800	6	6
9.	167	7	2	3·670	4	3	3·810	11	5
10.	166	5	4	4·300	7	3	5·900	12	7
11.	161	7	2	3·995	5	3	6·800	12	5
12.	153	3	3	5·065	3	3	7·050	6	6
13.	173	9	2	5·900	13	2	3·910	22	4
14.	168	4	4	11·700	10	3	20·000	14	7
15.	155	5	4	7·600	8	3	2·820	13	7
16.	161	4	4	3·750	4	4	7·150	8	8
17.	143	2	2	2·190	6	2	2·220	8	4
18.	178	10	6	4·700	11	4	5·000	21	10
19.	152	9	2	3·480	3	3	5·850	12	5
20.	170	5	4	4·300	7	2	3·850	12	6
21.	154	6	3	6·610	5	4	4·115	11	7
22.	157	6	3	2·200	6	3	2·405	12	6
23.	165	9	3	4·425	6	4	5·110	15	7
24.	165	6	3	4·200	7	4	4·280	13	7
25.	183	13	4	7·300	8	4	3·200	21	8
26.	171	7	5	13·000	8	5	4·080	15	10
27.	155	4	3	3·245	5	2	3·225	9	5
28.	160	5	5	4·400	11	5	8·315	16	10
29.	171	7	6	4·425	13	4	9·000	20	10
30.	147	5	2	2·835	5	4	2·715	10	6

other. In the other two cases, more corpora lutea were seen on the left side, when oviducal eggs were more on the side opposite.

Eleven of 15 *K. smithi* showed an extrauterine migration of ova (table 3, figure 3). Of the remaining four, three showed that the count of oviducal eggs

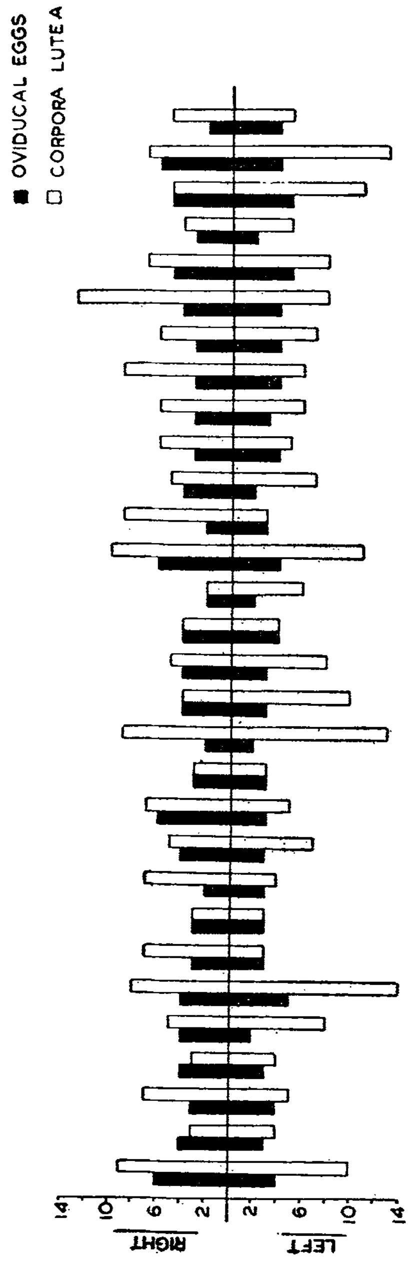

Figure 2. Comparative counts of oviducal eggs and copora lutea in *Kachuga t. tectum* (represented by black and white bars, respectively).

Table 3. Number of corpora lutea, eggs and ovarian weight (g) in *Kachuga smithi* on the right and left side of the body.

Sl. No.	Plastron length (mm)	Right side			Left side			Total number of corpus luteum	Total number of shelled eggs
		Corpus luteum	Shelled eggs	Wt. of ovary	Corpus luteum	Shelled eggs	Wt. of ovary		
1.	173	1	...	26·750	2	3	46·900	3	3
2.	176	7	3	42·750	5	3	18·775	12	6
3.	191	6	3	18·500	...	3	12·950	6	6
4.	160	6	4	17·350	2	4	14·350	8	8
5.	194	4	2	74·350	1	3	38·000	5	5
6.	197	4	4	43·000	3	3	44·100	7	7
7.	190	2	3	23·100	5	4	39·500	7	7
8.	192	4	4	36·450	2	2	41·100	6	6
9.	195	5	3	19·500	1	3	26·100	6	6
10.	199	4	5	29·000	6	5	41·000	10	10
11.	195	4	2	48·210	2	4	30·380	6	6
12.	173	1	3	9·300	3	1	30·200	4	4
13.	180	3	4	43·700	3	2	41·800	6	6
14.	192	3	3	35·510	3	3	22·800	6	6
15.	187	4	5	13·000	7	6	4·600	11	11
16.	193	1	1	14·000	2	2	5·500	3	3
17.	177	6	3	6·580	4	2	4·750	10	5

Figure 3. Comparative counts of oviducal eggs and corpora lutea in *Kachuga smithi* (represented by black and white bars, respectively).

differed from one another but corresponded well to the total number of corpora lutea as on their respective sides. One turtle had a balanced number of corpora lutea and oviducal eggs on each side. In the remaining 11 individuals, 5 showed more corpora lutea on the right side whereas the oviducal eggs were more on the left in only two, 3 showing equal number of eggs on both the sides. Out of the remaining six, 5 individuals showed more corpora lutea on left side but the oviducal eggs were more on the left in three, on the right in one and the fifth one had equal number of corpora lutea on the two sides, but the oviducal eggs were more on the right side.

The present studies have thus revealed that in *Lissemys p. punctata, Kachuga t. tectum* and *K. smithi,* the phenomenon of transabdominal migration of ova is of a relatively common occurrence. Seventy per cent of the *Lissemys p. punctata* ($N = 10$), 4% of *Kachuga t. tectum* ($N = 15$) and 73% of *K. smithi* ($N = 15$) studied for this phenomenon showed positive evidence of extra-uterine migration of ova. There is no previous record of such a high percentage of transfer as has been recorded presently in *Lissemys p. punctata* and *Kachuga smithi.* The previous highest report of ovular migration (66·6%) has been recorded in *Trionyx muticus* by Plummer (1977). Although reported in some other turtles as well the magnitude of the phenomenon in all of them is rather low being 57% in *Terrapene ornata* ; 13% in *T. cerdina* (Legler 1958) and 57% in *Sternotherus odoratus* (Tinkle 1959).

The present observations reveal that in individuals of smaller size below 250 mm (in plastron length) of *Lissemys p. punctata* (table 1), the transfer of ova is much higher (87·5%) than in the larger individuals (of plastron length above 250 mm) of the species. In *Kachuga smithi* of a plastral length of 210 mm or less, the migration is again higher (83%, table 2) than in its bigger individuals, where the transfer of ova was found to be only 49%. In *Kachuga t. tectum,* on the other, hand, the sample size being very small did not provide sufficiently reliable data. Thus our findings run counter to those of Tinkle (1959) who has reported for *Sternotherus odoratus,* that the extent of transabdominal migration of ova is higher in bigger individuals (62%) than in smaller ones (50%). Obviously the phenomenon is unrelated to size or age and could be a mere chance or an outcome of an occasional positional shift of the oviduct or ovaries known in reptiles (Cuellar 1970) during the act of encapsulation of the oocytes.

When viewed from the point of imbalance and differential weight of the ovary, a definite relationship between the weight of the ovary and the oviducal eggs on the same side as that of the ovary is evident. In 10 turtles of *Lissemys p. punctata* (table 1) with unequal number of eggs in the two oviducts, 7 showed lesser number of oviducal eggs on the side of heavier ovary, the other three greater number of oviducal eggs on the side of the heavier ovary. In *Kachuga t. tectum* (table 2) only one of the two individuals, suspected of transabdominal migration, had higher egg count on the side with heavier ovary. Of the 10 *Kachuga smithi* (table 3) turtles with imbalanced number of oviducal eggs, 7 showed a higher egg count in the oviduct on the side on which the ovary was lighter, the remaining 3 showing heavier ovary on the side with more eggs in the oviduct. After pooling the data from the three turtles and subjecting these to X^2, it is found that the P value stands between 0·05 to 0·20, which make deviation to be a matter of chance

Table 4. Percental values of corpora lutea during the breeding season in the two ovaries of *Lissemys p. punctata*, *Kachuga t. tectum* and *Kachuga smithi*.

Animal	Total number	Corpora lutea: Higher number Right (%)	Higher number Left (%)	Equal number on both sides (%)
Lissemys p. punctata	14	35·7	35·7	28·5
Kachuga t. tectum	30	26·6	56·6	16·6
Kachuga smithi	17	52·3	35·2	11·5

provided the assumption that the expected distribution of the eggs in the two oviducts would be equal (1 : 1). Since it is not so, the assumption stands untenable. It is therefore, suggested that the imbalance in number of eggs on the two sides has some significance and may help in achieving a better weight balance by having the greater number of ovulatory follicles on the side opposite the greater number of oviducal eggs, particularly in aquatic vertebrates, as has also been suggested earlier by Tinkle (1959).

A perusal of table 4 indicates that neither left nor right ovary in *Lissemys p. punctata* is consistently more productive than the other, although in the emydid turtles (*Kachuga t. tectum* and *K. smithi*) one of the two ovaries tends to be slightly more productive than the other. But the data in tables 1, 2 and 3 indicate that there is no positive relationship between greater productivity of any one ovary and the migration of the eggs. Present findings, however, do not support Legler's (1958) view that in reptiles, the two ovaries show differential activity in different years, one being more active during one breeding season than the other.

Nevertheless, a definite relationship appears to exist between the heavier ovary and lesser number of eggs on a side, as shown above. Should the asymmetrical position of the stomach in chelones have played any major role in the ovular migration as maintained by Hoddenbach (1966), then transabdominal would have been of a much wider and unfailing occurrence than reported or observed in lizards also in nearly all of which asymmetrical disposition of this stomach has been amply documented (Duda 1965).

In conclusion, therefore, the imbalance in the number of eggs on the two sides could be related in fair probably to the physiological necessity of achieving balance at least in the aquatic forms.

Acknowledgements

Authors are thankful to Dr Y R Malhotra, Professor and Head, Department of Biosciences, University of Jammu, for his constant encouragement and providing necessary facilities to conduct this work in the department. Financial assistance from the CSIR, New Delhi, is also acknowledged.

References

Arey L B 1954 *Developmental anatomy* (Philadelphia : Saunders) 6th ed. V–XI + 680 pp.

Asdell S A 1946 *Patterns of mammalian reproduction* (Ithaca : Comstock) XVI – 437 pp.

Cox W A and Marion K A 1978 Observations on the female reproductive cycle and associated phenomena in spring-dwelling population of *Sternotherus minor* in North Florida (Reptilia : Testudines) ; *Herpetologica* **34** 20–33

Cuellar O 1970 Egg transport in lizards ; *J. Morphol.* **130** 129–135

Duda P L 1965 *Functional morphology of Agama tuberculata* Gray. Ph.D. thesis, Kashmir University

Goldberg S R 1972 Reproduction in the southern alligator lizard *Gerrhonotus multicarinatus* ; *Herpetologica* **28** 267–273

Hoddenbach G 1966 Reproduction in western Texas, *Cnemidophorus sexlineatus* (Sauria; Teiidae): *Copeia* 1966 pp. 110–113

Legler J M 1958 Extra-uterine migration of ova in turtles ; *Herpetologica* **14** 49–59

Mayhew W W 1963 Reproduction in the granite spiny lizard, *Sceloporus orcutti* ; *Copeia* 1963 pp. 144–152

Mayhew W W 1965 Reproduction in the sand dwelling lizard, *Uma inornata* ; *Herpetologica* **21** 39–55

Mayhew W W 1966 Reproduction in the arenicolous lizard, *Uma notata* ; *Ecology* **47** 9–19

Mayhew W W 1971 Reproduction in the desert lizard, *Dipsosaurus dorsalis* ; *Herpetologica* **27** 57–77

Moll E O and Legler J M 1971 The life history of neotropical slider turtle, *Pseudemys scripta* (Schoepff) in Panama ; *Bull. Los. Ang. Country Mus. Nat. Hist. Sci.* **11** 1–102

Plummer M V 1977 Reproduction and growth in the turtle, *Trionyx muticus* ; *Copeia* 1977 pp. 440–447

Smith M A 1931 *The Fauna of British India, including Ceylon and Burma* (London : Taylor and Francis) pp. 188

Telford S R 1969 The ovarian cycle, reproductive potential and structure in a population of the Japanese lacertid *Takydromous tachydromoides* ; *Copeia* 1969 pp. 548–561

Tinkle D W 1957 Ecology, maturation and reproduction of *Thamnophis sauritus* proximus ; *Ecology* **38** 69–77

Tinkle D W 1959 Additional remarks on extra-uterine migration of ova in turtles ; *Herpetologica* **15** 161–162

Tinkle D W 1961 Population structure and reproduction in the lizard *Uta stansburiana steinogeri* ; *Am. Midl. Nat.* **66** 205–234

Weekes H C 1935 A review of placentation among reptiles with particular regard to the function and evolution of the Placenta ; *Proc. Zool. Soc. London* pp. 625–645

White J B and Murphy G G 1973 The reproductive cycle and sexual dimorphism of the common snapping turtle, *Chelydra serpentina serpentina* ; *Herpetologica* **29** 240–246