SOME OBSERVATIONS ON THE BREEDING BIOLOGY OF THE INDIAN FRUIT BAT, *CYNOPTERUS SPHINX* (VAHL) IN CENTRAL INDIA.

SATWANT SANDHU and A. GOPALAKRISHNA
Department of Zoology, Institute of Science, Nagpur 440 001, India.

ABSTRACT

Cynopterus sphinx (Vahl) breeds in Central India twice a year in quick succession bringing forth a single young one during each cycle. Most primiparous animals and adults exhibit a dextral physiological dominance of the female genitalia in the first sexual cycle in the year. The two sides of the female genitalia function alternately in the two successive cycles within the year. The sexual cycle in the males runs closely parallel to that of the females. Whereas the females attain sexual maturity within 5 to 6 months of age, the males do not become sexually mature within the year of their birth.

INTRODUCTION

RAMAKRISHNA[1] reported the occurrence of post-partum pregnancy in *Cynopterus sphinx sphinx*, and Moghe[2], while describing the embryology of *Cynopterus gangeticus*, mentioned that this species may breed twice in a year. Apart from these casual observations there is no report on the details of the breeding biology of any species of *Cynopterus*. Further, among the other pteropids from the Indian sub-continent, *Pteropus giganteus giganteus*[3,4] has a strict reproductive periodicity with copulation occurring in September–October and delivery taking place during the following April–May in Ceylon (Sri Lanka), which has an almost unvarying tropical climate throughout the year. The species has an anomalous pattern of reproduction with deliveries occurring during all the months except October to December in central India where seasonal climatic variations are quite pronounced. *Rousettus leschenaulti*[5,6] at and around Aurangabad experiences two pregnancies in quick succession in the year, and there is a physiological alternation of the two sides of the female genitalia in successive cycles without either side being physiologically dominant in the first cycle. The absence of any detailed report on the breeding habits of any cynopterid bat and the occurrence of wide differences among pteropids in different geographical regions prompted the authors to undertake a study of the breeding habits of *Cynopterus sphinx* (Vahl) in central India.

MATERIALS AND METHODS

The specimens of *Cynopterus sphinx* (Vahl) were collected at Nagpur at frequent intervals for two years commencing from 24 January 1982 such that every calendar month is represented by several collections. Altogether 601 specimens were collected and examined for the present report. The specimens were shot down with an air rifle from within the hollows formed by groups of dried fronds of palm trees. The body weight of each specimen was taken and the characters of the external genitalia were noted down. The reproductive organs and associated structures were dissected out and fixed in various fixatives. The tissues were processed as usual by dehydrating with graded ethanol, clearing in xylol, embedding in paraffin and sectioned at 3 to 8 μ thickness. For the present study the sections were stained with Ehrlich's haematoxylin and counterstained with eosin and mounted in DPX.

OBSERVATIONS AND DISCUSSION

The uterus is bicornuate and opens into the vagina by independent cervical canals as in other pteropids[7–10]. Parous females can be distinguished from the nulliparous adults in their first cycle by the fact that, whereas the former have prominent mammary nipples, the latter have almost insignificant nipples. The nipples commence to enlarge after mid-pregnancy in the primiparous animals and become conspicuously large after the first lactation and remain as such during the rest of the life.

Since the reproductive status of the animals on any given date was the same during the two years when these specimens were examined, only the dates and months are mentioned in the following descriptions. Every adult female experiences two pregnancies in the year. The first pregnancy cycle commences in the middle of October and ends with parturition occurring during the following February and March, and the

second pregnancy cycle, which overlaps the lactation period of the first cycle, continues until the middle of July. The earliest indication of unmistakable pregnancy, as revealed by the occurrence of a slightly swollen uterine cornu, was noticed in a specimen collected on 22nd October, and more and more specimens in the colonies became pregnant during the following weeks until every female was pregnant after the middle of November. Likewise, the deliveries occur in the colonies on different dates commencing from 16th February. In the first cycle the last date, on which a newly born young was noticed, was 20th March. After 20th February the females, which had delivered, not only carried a young one at the breast but also had conceived again. In many females, collected between the last week of February and the first week of April, one uterine cornu had an unmistakable bulb indicating pregnancy, but the contralateral cornu had not yet undergone complete involution and presented a typical post-partum condition. Evidently, the females had conceived within a short time after delivery during February and March. The first newly born young of the second cycle was collected on 21st June, after which there were progressively more deliveries in the colonies—the last newly born young being collected on 13th July. Since conception did not occur in all the females in the colonies synchronously, the females collected on any given date both in the first and in the second cycle were at different stages of pregnancy. The females carry the young ones incessantly for about 45 to 50 days, but suckling probably continues for another 10 days when the young ones were left behind in the roosts when the mothers went out for foraging. Evidently, during this phase there must have been community suckling since it would be impossible for the young ones to find their own mothers and *vice-versa*. The period from 13th July to the beginning of October is the sexually quiescent anoestrous period for this bat.

As already mentioned, the earliest date on which unmistakable pregnancy in the first cycle was noticed was 22nd October. This animal had, probably, undergone ovulation and fertilization three or four days earlier as could be determined by the stage of development of the embryo. The first date of delivery in the first cycle occurred on 16th February. This gives a gestation period of about 120 days. The first delivery in the second cycle was noticed on 21st June. This animal would have conceived on or about 20th February since the gestation period is about 120 days. Evidently, the second pregnancy in the year commences very soon after parturition of the first cycle. This is also evident by the fact already mentioned that in all the specimens showing early pregnancy in the second cycle, the contralateral uterine cornu was still in an uninvoluted post-partum condition.

Microscopic examination revealed that a large corpus luteum occupying the entire ovary persisted for a few days after parturition in February–March, thus necessitating the release of the Graafian follicle from the contralateral ovary after the first cycle in the year. The corpus luteum regressed after a few days after delivery so that within a few days after parturition in the second cycle in the year, the two ovaries of the specimens collected during August to October were similar in histological structure. The collection record indicates that 71 specimens out of 99 (that is about 72 %) bore the pregnancy in the right cornu during the first cycle and 26 out of 81 pregnant females (that is, about 32 %) bore the pregnancy in the right side in the second cycle. The situation in the second cycle is very nearly the opposite of what happens in the first cycle. This unquestionably establishes the fact that ovulation and pregnancy alternate between the two sides of the female genitalia during the two cycles in the year. However, in the first cycle the right side of the genitalia is distinctly physiologically dominant over the left. This contention is further supported by the fact that most of the primiparous females carried the pregnancy in the right cornu of the uterus. The situation in *C. sphinx* is, therefore, unique and unlike in any other bat exhibiting alternation of the two sides of the female genitalia in successive pregnancies. In all the other cases[9–12] the continued presence of the corpus luteum until after a few days after the commencement of the following pregnancy in all the cycles necessitates the occurrence of ovulation from the contralateral ovary. On the other hand in *C. sphinx* the corpus luteum disappears within a short time after parturition in the second cycle in June–July so that the ovaries present the same histological picture up to August. Hence, the occurrence of ovulation from the right ovary in most animals in the first cycle (that is, during October–November) indicates that there is a distinct dextral physiological dominance of the female genitalia in *C. sphinx*.

Whereas every female in the colony reaches adulthood and conceives by December (even those born during June–July) the males do not attain sexual maturity within the year of their birth as revealed by the fact that there were many sexually immature males during the breeding season. Further, the sex ratio in this bat varies at different stages of life. It is nearly even at birth (42 males and 40 females), and female

dominant during adult stage (127 males and 261 females). The sex ratio in the overall population is also female dominant (279 males and 322 females). Only during the prepubertal growth period are the males more than the females in number (110 males and 24 females). This is evidently due to the fact that whereas the females attain sexual maturity within a few months of age, the males take more than a year to reach sexual maturity. The pronounced female dominant sex ratio in the overall population in spite of an even sex ratio at birth can only be due to a preferential mortality of the males during the prepubertal growth period. The female dominant unbalanced sex ratio appears to be the rule among bats[13]. The only exception was noted in *Taphozous melanopogon* by Abdul Ali[14], who based his conclusions on a single examination of one small roost of this species. This species is a seasonally migratory bat. Hence, a definite conclusion regarding the sex ratio in this species can be established only by examining several roosts throughout the year. Such a work was recently undertaken by Khamare[15], whose preliminary studies have revealed that even this species may have a female dominant sex ratio.

The examination of the male specimens revealed that the weight of the testis reached two peak values, first during September–October and the second during January–March with a dip almost reaching the weight of the inactive testis during November–December and from April to August (figure 1). Histological examination revealed that the testis came to spermatogenetic activity late in August, and maintained vigorous spermatogenesis during September and October after which spermatogenesis nearly ceased. It spurted into activity again in January. From April to August the testis did not exhibit any spermatogenetic activity. Thus, the spermatogenetic ac-

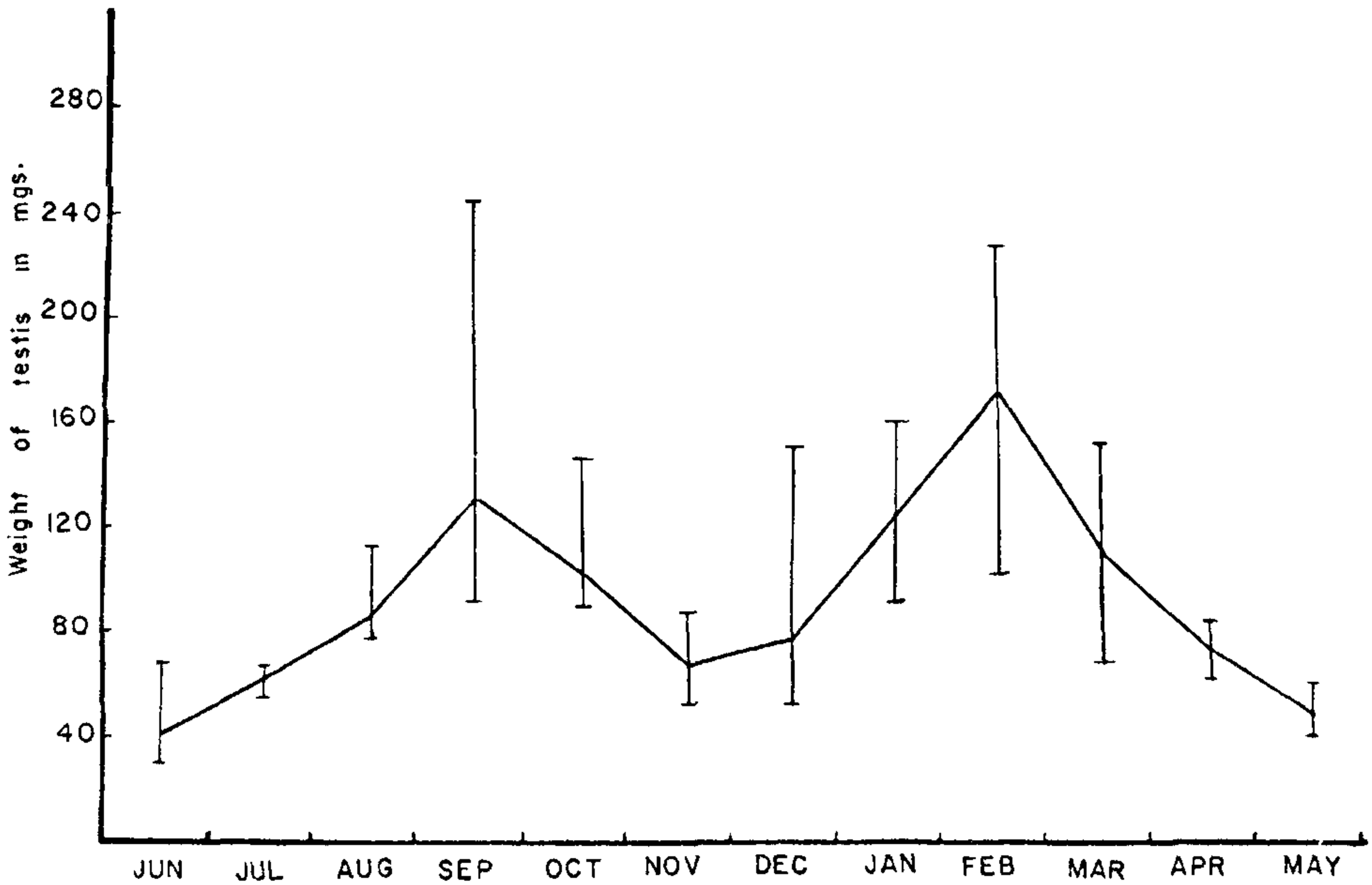

Figure 1. Graph in which the average weight of the right testis of all adult animals collected during the different months of the year are plotted against the middle of the respective month. Note the two peaks in the weight of the testis during the year. The maximum and minimum weights of the adult testis during each month are also indicated in the graph.

tivity in the testis closely paralleled the changes in its weight. These facts indicate that there are two distinct cycles of activity of the testis in this animal, and they closely correspond to the two periods of onset of sexual activity in the female.

ACKNOWLEDGEMENTS

The authors are thankful to the UGC for financial support to carry out this work.

3 July 1984; Revised 31 August 1984

1. Ramakrishna, P. A., *Curr. Sci.*, 1947, **16,** 186.
2. Moghe, M. A., *Proc. Natl. Inst. Sci. India*, 1956, **22,** 48.
3. Marshall, A. J., *Proc. Linn. Soc. London*, 1947, **159,** 103.
4. Sahasrabudhe, J. D., *J. Bombay Nat. Hist. Soc.*, 1971, **67,** 550.
5. Gopalakrishna, A., *Curr. Sci.*, 1964, **33,** 558.
6. Gopalakrishna, A. and Choudhari, P. N., *J. Bombay Nat. Hist. Soc.*, 1977, **74,** 1.
7. Grasse, P. P., In "*Traite de Zoologie*", Masson et Cie, Paris, 1955, **17,** 1728.
8. Ashfaque, M. and Tungare, S. M., *Bull. Zool. Soc., Coll. Sci. Nagpur*, 1960, **3,** 1.
9. Choudhari, P. N., "*Sex cycle and associated phenomena in the Indian fruit bat, Rousettus leschenaulti* (Desm.)" Unpublished thesis, Nagpur University, 1968.
10. Gopalakrishna, A. and Karim, K. B., *Golden Jubilee Volume, Natl. Acad. Sci. India*, 1980, 1.
11. Gopalakrishna, A., *Curr. Sci.*, 1954, **23,** 60.
12. Gopalakrishna, A., *Proc. Natl. Inst. Sci. India*, 1955, **21,** 29.
13. Gopalakrishna, A. and Madhavan, A., *J. Bombay Nat. Hist. Soc.*, 1970, **67,** 171.
14. Abdul Ali, H., *J. Bombay Nat. Hist. Soc.*, 1952, **48,** 423.
15. Khamare, K. G., "*Reproduction in the Indian sheath-tailed bat, Taphozous melanopogon* (Temminck)", unpublished thesis, Nagpur University, 1981.

NEWS

MISDIAGNOSING LOW BLOOD SUGAR

. . . "The American Diabetes Association recently issued a new warning on the false diagnosis of hypoglycemia. Yet some physicians and patients still grab onto it just to have a medical diagnosis for what are often ill-defined symptoms. . . . True hypoglycemia is a serious medical problem. It is not a disease, but rather an indication of an underlying disorder. It may be caused by a number of conditions, including excess insulin, pituitary and adrenal failure, hepatic disease, malignant tumours, or even ingestion of drugs or alcohol. It can also be reactive, suffering after meals in patients who have had surgery on their stomach or upper bowel. Dramatically effective therapy is often available. In contrast, patients . . . who are wrongly diagnosed as hypoglycemic are often unnecessarily placed on unusual diets such as those emphasizing high protein foods. . . . Unfortunately, many patients actually welcome the diagnosis because it provides a medically appealing, socially acceptable explanation for their problems. It relieves them from responsibility for changing the unsatisfactory aspects of their lives. Occasionally, patients are hostile to the announcement that they do not have hypoglycemia. Hypoglycemia does exist, but it is not nearly as common as the number of patients with the diagnosis seems to indicate." (Reproduced with permission from: *Press Digest, Current Contents*®, No. 39, September 24, 1984, p. 15; Copy right by the Institute for Scientific Information® Philadelphia, PA, USA)