OBSERVATIONS ON THE BREEDING HABITS AND OVARIAN CYCLE IN THE INDIAN SHEATH-TAILED BAT, *TAPHOZOUS LONGIMANUS* (HARDWICKE)

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CONTENTS

1. INTRODUCTION

A study of the reproductive habits of *Taphozous longimanus* was undertaken because there is no detailed account of the sex-cycle and breeding seasons of any member of the family Emballonuridae amongst the microchiroptera. Blandford (1888) observed that a female of *Taphozous longimanus* collected at Calcutta in July had a young adhering to the breast. Matthews (1941) recorded that in *Caelura afra* 'The breeding season occurs several weeks later in the year than it does in other species of bats.' Beyond such casual observations no details have been mentioned with regard to the breeding seasons of these species by the authors.

Review of literature on the reproductive phenomena of bats has been given by several authors (Duval, 1895; Hartman, 1933; Baker and Bird, 1936; Wimsatt, 1942 and Gopalakrishna, 1947). The reproductive patterns of bats so far studied can be classified into the following types:—(i) Copulation takes place in autumn and the inseminated sperms hibernate inside the genital tract of the female throughout winter and fertilize the ova in the next spring. This phenomenon has been observed by Rollinat and Trouessart (1895, 1896 and 1897) in *Vespertilio murinus* and *Rhinolophus ferrum equinum*, by Matthews (1937) in the British horse-shoe bats and by Wimsatt (1942) in *Myotis lucifugus lucifugus*. (ii) Copulation normally takes place in autumn and the inseminated sperms hibernate inside the genital tract of the female and fertilize the ova in next spring. But those females which missed copulation in autumn undergo copulation in the following spring and pregnancy follows immediately. This has been reported by Guthrie (1933) in *Myotis*

lucifugus lucifugus. (iii) Copulation takes place late in autumn and fertilization and pregnancy follow immediately and young ones are produced in the following spring. This was reported by Gopalakrishna (1950) in *Lyroderma lyra lyra*, and by Ramakrishna (1951) in *Lyroderma lyra lyra* and *Megaderma spasma*. (iv) Copulation occurs in spring and is immediately followed by fertilization and pregnancy. This has been reported by Baker and Bird (1936) in *Miniopteris australis* and by Gopalakrishna (1947) in *Scotophilus wroughtoni*.

In all the cases mentioned above there is one common feature. The species breeds only once a year in a sharply defined season and wean only one litter per year. Hence during the season when the females are pregnant they bear conceptuses of practically the same age at any given time. Production of more than one litter per year was recorded by Ramaswami (1933) in *Vesperugo leisleri* and by Matthews (1941) in *Nycteris luteola*. But these authors do not mention details of the sexual cycle. (v) A detailed account of the breeding season and female sexual cycle has been given by Wimsatt and Trapido (1952) in *Desmodus rotundus*. They record that this species behaves quite unlike other bats so far studied, in that there is no special breeding season, but it breeds throughout the year. Each female after attaining maturity brings forth at least two litters in quick succession per year.

2. Material and methods

Specimens of *Taphozous longimanus* were collected in the vicinity of Nagpur and Amaravati (Madhya Pradesh). These are small bats clinging to the walls of old houses. Some specimens were also collected from the hollows of big trees. *Taphozous longimanus* is not colonial in habit, but lives either singly or in groups of three or four.

Collection of material commenced in October, 1947 and the last batch for the present study was collected in August, 1953. Excepting during the months of April and May collections were made to represent all the calendar months of the year. In all 135 females and 50 males were collected.

Specimens captured or shot by air-gun were weighed immediately. The genitalia of the females were fixed in alcoholic Bouin's fluid. In cases of some pregnant specimens other fixatives like Rassman's fluid, neutral formalin and Carnoy's fluid without acetic acid were also employed for future cytochemical study. Uteri with advanced conceptuses were slit open to facilitate proper fixation. After the usual method of dehydration and embedding sections were cut 10μ thick and stained with Delafield or Ehrlich's haematoxylin and counterstained with eosin.

The collection diary drawn from field record is appended. A summary of the collection diary with relevant details is also given for easy reference. (See Appendix and Table I.)

3. Observations and discussion

(*a*) *Breeding seasons.*

The collection diary reveals several interesting features which are rather unusual amongst the insectivorous bats. Pregnant females were found in all the months of the year. The absence of collections in April and May does not seriously affect this conclusion because in June females in advanced pregnancy were found. In the record of the collections for each month as well as amongst a group of females collected at several individual collections, females are found at different stages of growth and sexual activity such as, females in advanced pregnancy, females in early pregnancy, females in full lactation carrying young at the breast and also non-pregnant females.

It is thus obvious that there is no restricted breeding season for *Taphozous longimanus*, and hence this species differs from most of the insectivorous bats so

far studied which have a sharply defined breeding season and hence show pregnancy during only certain months of the year.

In *Taphozous longimanus* there is ample evidence to show that each female becomes pregnant more than once in a year and most probably there is continuous breeding with pregnancies following in quick succession. These conclusions are borne out by the following observations:—32 females collected during different months of the year were in full lactation as evidenced by the presence of a young adhering to the breast or by the exudation of milk when the nipples were squeezed. Of these 16 showed on dissection that they were pregnant also. In 5 of these cases the ovary of the non-pregnant side showed a degenerating corpus luteum of the previous pregnancy (Pl. V, fig. 11). This shows that pregnancies follow one another in quick succession. It is not possible to state with the help of the material at my disposal, how soon after parturition, does the next oestrous cycle start. This period should obviously be very short since the corpus luteum of the previous pregnancy has not undergone complete resorption when the next pregnancy has started.

Another fact which supports this conclusion is that out of 135 females collected during six years, 100 specimens showed either pregnancy or lactation or both, leaving only 16 which were neither pregnant nor in lactation; and 19 which were decidedly immature since they were very small and were attached to their mothers' breasts. Microscopic examination of the ovaries of specimens weighing 26·4 gms. and less, revealed that they were similar to the juvenile females. But the ovaries of specimens weighing more than 26·4 gms. had vesicular graafian follicles and therefore could be considered as adult specimens. The lowest body weight of a pregnant female in my collection is 31·6 gms. (the uterus in this specimen had an early implanted blastocyst), and excepting two specimens every female which weighed 31·6 gms. and over was either pregnant or in lactation. The two exceptional females weighed 32·8 gms. and 32·4 gms. respectively and their ovaries (Pl. IV, fig. 4 and Pl. V, fig. 9) contained large vesicular graafian follicles suggestive of approaching pro-oestrum. The nipples of the mammary glands of these specimens were small. It is very probable that these specimens were on the threshold of their first oestrous cycle. The foregoing arguments suggests that all the non-pregnant females in my collection were also non-parous without having become pregnant even once. This percentage is so small in the total population that it could only mean that after the attainment of sexual maturity the females breed continuously without there being any pronounced anoestrus period between successive pregnancies.

How many litters does a female produce per year cannot be determined because I have no criterion to decide the period of gestation.

Thus *Taphozous longimanus* differs from most of the insectivorous bats and resembles only *Desmodus rotundus* (Wimsatt and Trapido, 1952). It is noteworthy that the other species of bats which are reported to bring forth more than one litter per year such as *Vesperugo leisleri* (Ramaswami, 1933), *Nycteris luteola* (Matthews, 1941) and *Desmodus rotundus* (Wimsatt and Trapido, 1952) are tropical species. The occurrence of continuous breeding in *Taphozous longimanus* inhabiting a region like Nagpur where the summer is very hot, the rainy season is confined to the months of June, July, August and part of September and the winter is fairly cold is interesting because the seasonal changes in the climatic conditions are very marked.

(*b*) *Sex-ratio.*

There seems to be a very abnormal sex-ratio in *Taphozous longimanus.* During six years of random collection 135 females and 50 males were collected. The occurrence of an abnormal sex-ratio, with females predominating, has been observed

in many other species of insectivorous bats by earlier workers (Blandford, 1888; Phillips, 1935; Baker and Bird, 1936; Wimsatt, 1945; Abdulali, 1948; Gopalakrishna, 1947 and 1950; Ramakrishna, 1951). In these species worked out by these authors there is a sharply defined breeding season and therefore there is a possibility that the males and the females live in separate colonies excepting at the time of breeding. It may, therefore, be difficult to determine the actual sex-ratio in these species. But this difficulty is not encountered in *Taphozous longimanus* as it breeds throughout the year and is not colonial in habit. Further, the collection data shows that this abnormality in sex-ratio is found in all the months of the year. Even the immature ones collected from the breasts of the mothers show this disparity in numbers—19 females to 10 males. Hence the proportion of females to males as is indicated by the collection record should be very nearly the natural sex-ratio in this species.

(*c*) *General plan of the female reproductive organs.*

As in most insectivorous bats (excepting the members of the family Phyllostomidae) the female reproductive organs consist of a pair of ovaries, a bicornuate uterus and a non-septate vagina. The ovaries are oval in shape and are enclosed in a complete ovarian capsule. The fallopian tube arises from the median aspect of the ovarian capsule, takes a circuitous course over the capsule and joins the respective uterine cornu. The uterine cornua are equally developed and meet posteriorly at an acute angle forming a 'V' shaped structure. The uterine cervix projects a short distance into the vagina which opens to the outside on a slight elevation.

(*d*) *Number of embryos in a litter.*

Though the uterus is bicornuate and equally developed only one young is produced in each litter, and the embryo may be either in the right horn or in the left horn of the uterus. In 88 specimens in which the uterus unmistakably showed either pregnancy or post-partum condition, 39 had it in the right horn and 49 in the left. Further in the cases of pregnant females whose ovaries were sectionised, the corpus luteum occurred in the ovary of the same side in which the uterine horn had pregnancy. In 5 cases of females which showed post-partum pregnancy the ovary of the non-pregnant side had a degenerate corpus luteum of the previous pregnancy. This taken along with the fact that there is quick succession of pregnancies indicates that ovulation alternates between the two ovaries and pregnancy alternates between the two horns of the uterus in successive pregnancies.

In most microchiroptera only one young is produced in each litter. Only in a few species more than one is brought forth in each litter (Ramaswami, 1933; Wimsatt, 1945; Gopalakrishna, 1947; Uchida, 1950). Further in several monotokous bats there is a tendency for the genitalia to become physiologically asymmetrical and only one side to become functional, and in most cases the foetus is borne in the right horn (Jones, 1917; Guthrie, 1933; Baker and Bird, 1936; Matthews, 1937; Wimsatt, 1945). In extreme cases like *Rhinolophus hipposiderus minutus* (Matthews, 1937) the left ovary does not even produce mature ova and shows signs of atrophy. Though *Taphozous longimanus* consistently brings forth a single young each time there is no physiological asymmetry, but presumably there is an alternation of the two sides of the genitalia in successive pregnancies.

While three or four follicles undergo development simultaneously to full size, only one undergoes rupture in *Taphozous longimanus*. I have not got a single specimen which showed more than one corpus luteum in the ovary. In several monotokous bats more than one ovum may be shed (Wimsatt, 1945; Wimsatt and Trapido, 1952).

(*e*) *Microscopic examination of the ovaries.*

(i) *Juvenile ovary.*—The following description refers to the ovaries of specimens which were attached to the breasts of their mothers. The body weights range between 10·6 gms. to 18·6 gms. There is not much difference in the structure of the ovaries of the different specimens or between the ovaries of the two sides of the same specimen (Pl. IV, fig. 1).

The germinal epithelium consists of cuboidal cells, each with a large spherical nucleus centrally placed in the cell (Pl. IV, fig. 2). Here and there some cells of the germinal epithelium are larger than the rest of the cells of the germinal epithelium and they bulge inwards. These are unmistakably the mother cells of the oocytes and they migrate inwards towards the deeper regions of the ovary during further development. As the oocyte migrates inwards it becomes surrounded by a circlet of flattened cells—the satellite cells of the primordial follicle. The peripheral part of the ovary contains a large number of such primordial follicles (Pl. IV, fig. 2).

As the follicles increase in size the follicle cells become at first cuboidal and later columnar with the nuclei occupying the distal poles of the cells thus leaving a hyaline region of cytoplasm immediately surrounding the ovum. There is also a progressive increase in the number of the follicle cells.

The tunica albuginea is imperfectly developed and there is no clear distinction between the cortical and medullary part of the ovary.

In the deeper regions of the ovary there are a number of unilaminar follicles (Pl. IV, fig. 3). The oocyte nucleus becomes eccentric by the time the unilaminar follicle reaches its full size. The follicles in the juvenile specimens do not develop beyond the unilaminar stage because follicular atresia set in before the bilaminar stage is reached. The onset of follicular atresia is indicated by the oocyte losing its spherical shape and becoming irregular. The nucleus becomes highly pycnotic and finally the oocyte undergoes degeneration. Atresia of the follicle cells follow the degeneration of the oocyte so that for a short time while the oocyte is undergoing degeneration there is an actual increase in the size of the follicle and mitotic division of the follicle cells continues even though the oocyte shows distinct signs of degeneration.

(ii) *Growth changes in the ovary.*—The histological details of the ovary undergo but little change until the specimen reaches a body weight of 26·4 gms., while the ovaries of specimens weighing more than 26·4 gms. show a distinct advance over the ovaries of the juvenile ones (Pl. IV, fig. 6). The germinal epithelium is characterized by the occurrence of more epithelial nodules—the fore-runners of oocytes—indicating an increase of the ovogenetic potentiality of the germinal epithelium. The ovarian medulla contains follicles in advanced stages of development (Pl. IV, fig. 5).

The development of the follicle follows the same pattern as in other mammals. During the early stages of growth there is a simultaneous increase of the oocyte and the follicle as a whole, but after the oocyte reaches its maximum size only the follicle increases, first by the proliferation of the cells and later by the formation and growth of the antrum.

The fully formed graafian follicle (Pl. V, fig. 7) shows certain interesting details. The theca folliculi consists of 4 to 6 layers of closely packed fusiform cells. A clear distinction between the theca externa and the theca interna cannot be made out. Small capillaries are seen in this layer. The theca is predominantly cellular and the general fibrous appearance is due to the fact that the cells of the theca are fusiform and their nuclei spindle shaped. The granulosa layer has a distinct basement membrane and consists of 8 to 10 layers of cells with spherical nuclei. The oocyte is placed eccentrically and is attached to the granulosa layer. A definite conical cumulus as is noticed in many mammals is not present—the granulosa layer being as thick in the region of the attachment of the ovum as in the rest of the

follicle. A very interesting feature of the graafian follicle of *Taphozous longimanus* is that there is a single layer of cells surrounding the oocyte. The antrum is filled with liquor folliculi.

The fully formed graafian follicle of *Taphozous longimanus* has, therefore, certain unique characters. The oocyte of *Myotis lucifugus lucifugus* (Wimsatt, 1944; and Guthrie and Jeffers, 1938) is supported within the follicle by a large number of polygonal cells extending from the region of the discus to the granulosa. This is also the case in *Scotophilus wroughtoni* (Gopalakrishna, 1949). Obviously it seems that there are differences in the histological details of the graafian follicle in particular and the ovaries in general in the different species of bats. Probably a careful examination of the ovaries might reveal that there are fundamental differences between species.

Follicular atresia is common in the adult ovaries and most often it sets in when the follicle reaches the multilaminar condition. Some follicles undergo degeneration at later stages of development of the follicle.

(iii) *Changes in the ovaries of the pregnant female.*—The most striking feature of the ovary of the pregnant side in a pregnant specimen is the presence of the corpus luteum. In a specimen having an early implanted blastocyst the corpus luteum occupies about half of the ovary (Pl. V, fig. 8). The central cavity of the corpus luteum has disappeared and its place is occupied by large vacuolated cells. By the time the embryo reaches the limb-bud stage of development the corpus luteum has grown enormously and occupies practically the entire ovary. Centripetally arranged fibrous strands are present in the corpus luteum (Pl. V, fig. 10).

The histology of the ovary of the non-pregnant side during pregnancy does not seem to have attracted the attention of workers so far. During very early pregnancy the ovary of the non-pregnant side of 5 specimens contained a degenerate corpus luteum of the previous pregnancy (Pl. V, fig. 11). As pregnancy advances the histological details of the ovary on the non-pregnant side also shows change. Follicular development continues as in a non-pregnant female excepting that the follicle undergoes degeneration at the vesicular stage. In a transverse section of the ovary of the non-pregnant side of a pregnant specimen a number of vesicular follicles can be seen. It is interesting to note that the ovary of the non-pregnant horn does not seem to remain quiescent but shows all stages of activity except the actual development of the graafian follicle to its maximum size. In a specimen showing advanced pregnancy the ovary of the non-pregnant side (Pl. V, fig. 12) contained three well developed graafian follicles with antra. This is an added circumstantial evidence to support the conclusion that there is continuous breeding and that there is a functional alteration of the two sides of the genitalia in successive pregnancies.

4. Summary

1. The paper embodies observations on the breeding habits and the ovarian cycle in *Taphozous longimanus*.

2. *Taphozous longimanus* breeds all round the year and there is a quick succession of pregnancies.

3. There is a very abnormal sex-ratio with females predominating over males in this species.

4. A single young is brought forth in each litter, and the pregnancy alternates between the two horns of the uterus.

5. Ovulation occurs in the ovary of the same side in which there is pregnancy.

6. The fully formed graafian follicle differs from that of most other bats in having a single layer of cells surrounding the ovum.

7. The ovary of the non-pregnant side of a pregnant specimen shows continued activity.

5. Acknowledgements

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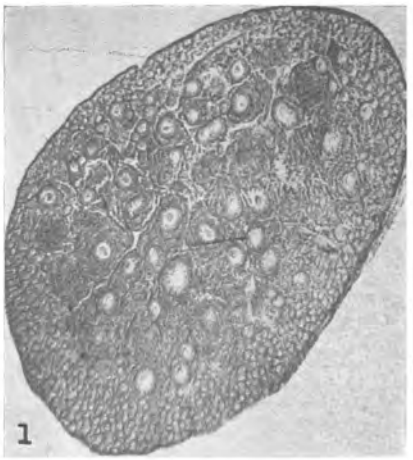
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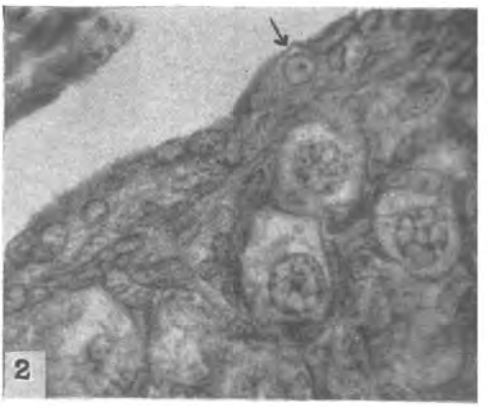
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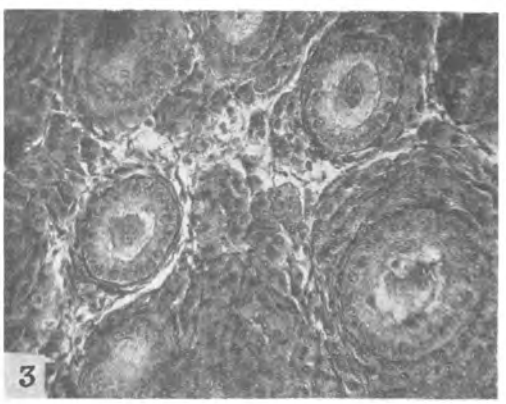
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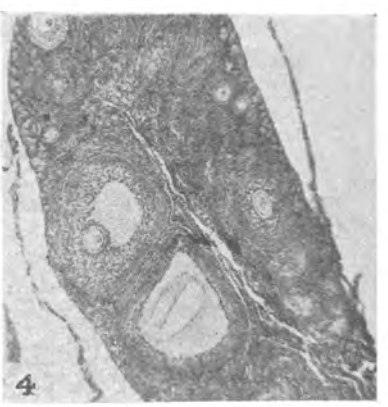
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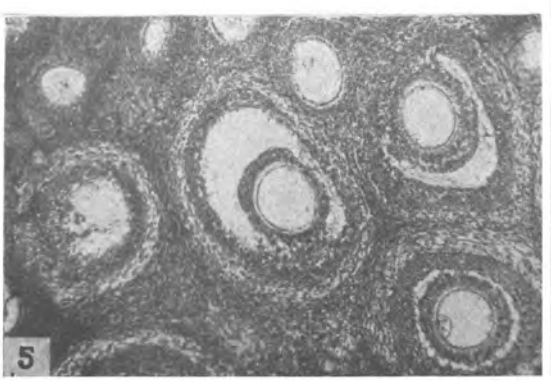
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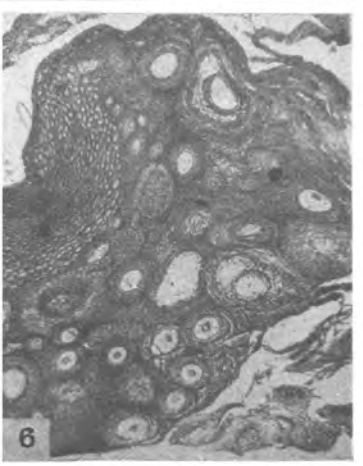
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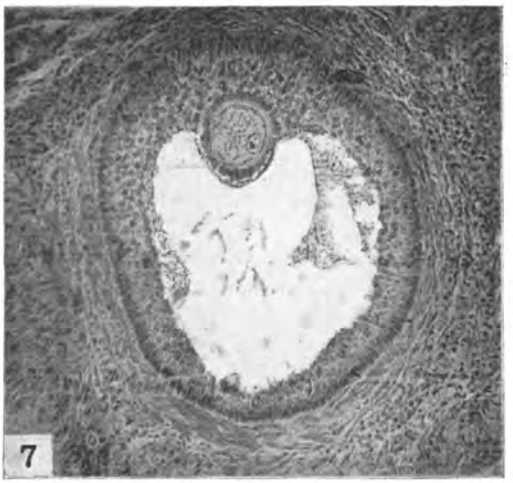
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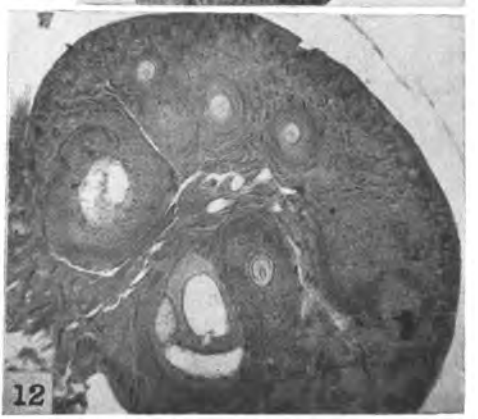
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work was carried out. My thanks are also due to the authorities of the National Institute of Sciences of India for awarding me a research fellowship to complete this work.

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7. Appendix

Collection diary of Taphozous longimanus (*Hardwicke*)

Date of collection	Sp. No.	Body weight in gms.	Sex	Particulars
January:				
16-1-1952 ..	A*	..	Female ..	Lactating, with young at breast (C). Right horn of uterus shows pregnancy again.
,, ..	B	..	,, ..	Lactating; young lost. Post-partum uterus right horn.
,, ..	C	..	,, ..	Young from breast of 'A'.
,, ..	D	..	Male ..	Adult male.
,, ..	E	..	,, ..	Adult male.
18-1-1949 ..	36	46·2	Female ..	Advanced pregnancy in right horn.
,, ..	37	32·8	,, ..	Non-pregnant.
,, ..	38	36·4	Male ..	Adult.
28-1-1950 ..	64	42·0	Female ..	Advanced pregnancy in right horn.
,, ..	65	43·0	,, ..	Early pregnancy in left horn.
February:				
6-2-1953 ..	RR	14·4	Female ..	Young; mother escaped.
16-2-1948 ..	14	26·0	,, ..	Non-pregnant.
16-2-1953 ..	139	32·8	,, ..	Mid-pregnancy in right horn.
,, ..	140	32·6	,, ..	Early pregnancy in left horn.
25-2-1953 ..	141	36·4	,, ..	Early pregnancy in right horn.
,, ..	142	33·8	Male ..	Adult.
,, ..	143	37·6	,, ..	Adult.
26-2-1953 ..	144*	37·4	Female ..	Lactating; young lost; again pregnant in right horn.
,, ..	145	36·8	Male ..	Adult.
28-2-1953 ..	ZZ	30·2	Female ..	Non-pregnant.
,, ..	MM	12·6	,, ..	Young; mother escaped.
,, ..	KK	36·4	,, ..	Early pregnancy in right horn.
,, ..	SS	38·2	Male ..	Adult.
,, ..	TT	36·0	,, ..	Adult.
March:				
3-3-1948 ..	15*	34·3	Female ..	Lactating; early pregnancy in right horn.
,, ..	16	36·2	,, ..	Early pregnancy in right horn.
,, ..	17	30·5	Male ..	Adult.
,, ..	18	42·4	Female ..	Advanced pregnancy in left horn.
3-3-1953 ..	150	34·5	,, ..	Early pregnancy in left horn.
,, ..	151	38·4	,, ..	Early pregnancy in left horn.
,, ..	152	35·8	Male ..	Adult.
,, ..	153	41·2	,, ..	Adult.
,, ..	154	16·1	,, ..	Young; mother escaped.
10-3-1953 ..	155	43·5	Female ..	Advanced pregnancy in right horn.
13-3-1949 ..	39*	32·5	Female ..	Mother lactating with a young (44) in the breast; early pregnancy in right horn.
,, ..	40	36·2	,, ..	Early pregnancy in left horn.
,, ..	41	41·0	,, ..	Advanced pregnancy in left horn.
,, ..	42	31·6	,, ..	Early pregnancy in left horn.
,, ..	43	28·2	,, ..	Non-pregnant.
,, ..	44	16·2	,, ..	Young from breast of Sp. No. 39.
,, ..	45	36·0	,, ..	Lactating, right horn post-partum. Young lost.

APPENDIX—*Contd.*

Collection diary of Taphozous longimanus (*Hardwicke*)

Date of collection	Sp. No.	Body weight in gms.	Sex	Particulars
April: No collections.				
May: No collections.				
June:				
26-6-1948 ..	19	38·4	Female ..	Advanced pregnancy in right horn.
,, ..	20	32·0	Male ..	Adult.
26-6-1953 ..	AA	30·5	Female ..	Non-pregnant.
,, ..	BB	12·6	Male ..	Young; mother escaped.
,, ..	CC	13·2	Female ..	Young from the breast of Sp. No. DD.
,, ..	DD	36·5	,, ..	Lactating with young (CC) at breast.
,, ..	EE	39·0	,, ..	Early pregnancy in right horn.
,, ..	FF	42·4	,, ..	Advanced pregnancy in left horn.
,, ..	GG	40·5	,, ..	Lactating; post-partum on right side.
,, ..	HH*	38·2	,, ..	Lactating; young lost, again pregnancy in left horn.
,, ..	II	11·5	,, ..	Young; mother escaped.
July:				
6-7-1953 ..	J(1)	31·2	Female ..	Non-pregnant.
,, ..	J(2)	44·4	,, ..	Lactating with young at breast J(3).
,, ..	J(3)	10·6	,, ..	Young from the breast of Sp. No. J(2).
,, ..	J(4)	29·2	,, ..	Non-pregnant.
,, ..	J(5)	32·4	,, ..	Non-pregnant.
11-7-1948 ..	21	41·4	,, ..	Advanced pregnancy in right horn.
,, ..	22	28·2	Male ..	Adult.
28-7-1948 ..	23	24·2	,, ..	Adult.
August:				
16-8-1948 ..	24	31·0	Male ..	Adult.
18-8-1952 ..	66	44·2	Female ..	Advanced pregnancy in right horn.
18-8-1953 ..	Au(1)	32·4	Male ..	Adult.
21-8-1952 ..	67	13·2	Female ..	Young; mother escaped.
22-8-1952 ..	68	42·5	,, ..	Advanced pregnancy in left horn.
,, ..	69	38·4	,, ..	Advanced pregnancy in right horn.
,, ..	70	41·4	,, ..	Advanced pregnancy in left horn.
,, ..	71	39·5	,, ..	Advanced pregnancy in left horn.
,, ..	72	31·8	,, ..	Early pregnancy in left horn.
,, ..	73	39·2	,, ..	Lactating with young at breast.
,, ..	74	13·5	Male ..	Young from breast of Sp. No. 73.
29-8-1952 ..	75	..	Female ..	Early pregnancy in left horn.
30-8-1952 ..	76	40·5	,, ..	Advanced pregnancy in right horn.
,, ..	77	38·0	,, ..	Advanced pregnancy in right horn.
,, ..	78	41·2	,, ..	Advanced pregnancy in right horn.
,, ..	79*	38·4	,, ..	Lactating with young (83); again pregnant in right horn; early pregnancy.
,, ..	80	38·2	,, ..	Advanced pregnancy in right horn.
,, ..	81	36·5	,, ..	Early pregnancy in left horn.
,, ..	82	36·5	,, ..	Mid-pregnancy in left horn.
,, ..	83	14·2	,, ..	Young female from breast of Sp. No. 79.
,, ..	84	38·0	,, ..	Lactating with young in breast; young lost.
,, ..	85	40·0	,, ..	Advanced pregnancy in right horn.
,, ..	86	43·3	,, ..	Advanced pregnancy in right horn.

Collection diary of Taphozous longimanus (*Hardwicke*)

APPENDIX—*Contd.*

Date of collection	Sp. No.	Body weight in gms.	Sex	Particulars
September:				
5-9-1952 ..	87	38·2	Female ..	Advanced pregnancy in right horn.
,, ..	88	36·2	,, ..	Early pregnancy in left horn.
,, ..	89	44·5	,, ..	Advanced pregnancy in left horn.
,, ..	90	41·4	,, ..	Advanced pregnancy in right horn.
,, ..	91*	35·6	,, ..	Lactating female with young (91*a*) in the breast. Again pregnancy in left horn.
,, ..	91*a*	12·8	,, ..	Young from breast of No. 91.
,, ..	92	14·2	,, ..	Young female; mother escaped.
,, ..	93	38·0	Male ..	Adult.
,, ..	94	34·2	,, ..	Adult.
,, ..	95	26·2	,, ..	Adult.
,, ..	96	15·2	,, ..	Young from breast of No. 97.
,, ..	97*	38·5	Female ..	Lactating with young in the breast (Sp. 96); again early pregnancy in left horn.
6-9-1948 ..	25	..	Female ..	Early pregnancy in right horn.
,, ..	26*	..	,, ..	Lactating female; again pregnancy in left horn.
,, ..	27	..	,, ..	Advanced pregnancy in right horn.
,, ..	28	..	,, ..	Lactating with young at breast; young lost.
,, ..	29	..	Male ..	Adult.
,, ..	30	..	,, ..	Adult.
20-9-1952 ..	98	..	Female ..	Advanced pregnancy in right horn.
,, ..	99*	..	,, ..	Lactating mother. Early prgenancy in right horn.
,, ..	100	..	,, ..	Advanced pregnancy in left horn.
,, ..	101	..	,, ..	Lactating with young (104) at breast.
,, ..	102	..	,, ..	Non-pregnant.
,, ..	103	..	,, ..	Lactating with young at breast (108).
,, ..	104	..	,, ..	Young female from Sp. No. 101.
,, ..	105	..	Male ..	Adult.
,, ..	106	..	,, ..	Adult.
,, ..	107	..	,, ..	Adult.
,, ..	108	..	,, ..	Young from the breast of Sp. No. 103.
,, ..	109	..	Female ..	Young; mother escaped.
22-9-1949 ..	46	31·6	,, ..	Early pregnancy in right horn.
,, ..	47	36·2	,, ..	Early pregnancy in right horn.
,, ..	48	35·0	,, ..	Lactating with young in breast; young lost.
,, ..	49	32·0	Male ..	Adult.
29-9-1952 ..	110	41·5	Female ..	Advanced pregnancy in right horn.
,, ..	111	36·0	Male ..	Adult.
,, ..	112	33·0	,, ..	Adult.
,, ..	113	26·5	,, ..	Adult.
,, ..	114	11·6	Female ..	Young female; mother escaped.
October:				
5-10-1952 ..	115	..	Female ..	Advanced pregnancy in left horn.
,, ..	116	..	,, ..	Early pregnancy in left horn.
,, ..	117	..	,, ..	Lactating; right horn post-partum.
,, ..	118	..	Male ..	Adult.
,, ..	119	..	,, ..	Adult.
20-10-1952 ..	120	13·4	,, ..	Young from breast of Sp. No. 122.

Collection diary of Taphozous longimanus (*Hardwicke*)

APPENDIX—*Contd.*

Date of collection	Sp. No.	Body weight in gms.	Sex	Particulars
October:—Contd.				
20-10-1952 ..	121	30·3	Female ..	Non-pregnant.
,, ..	122*	34·0	,, ..	Lactating with young (120); again pregnancy in right horn.
,, ..	123	40·5	,, ..	Advanced pregnancy in left horn.
,, ..	124	39·2	,, ..	Advanced pregnancy in left horn.
,, ..	125	36·2	,, ..	Advanced pregnancy in right horn.
,, ..	126	38·4	,, ..	Mid-pregnancy in left horn.
21-10-1947 ..	1	41·2	,, ..	Very late pregnancy in left horn.
,, ..	2	36·2	,, ..	Early pregnancy in left horn.
,, ..	3	38·0	,, ..	Early pregnancy in left horn.
,, ..	4	36·0	,, ..	Lactating female; right horn post-partum.
,, ..	5	38·0	,, ..	Lactating; right horn post-partum.
,, ..	6	34·0	,, ..	Non-pregnant.
,, ..	7	28·0	Male ..	Adult.
29-10-1949 ..	50	34·6	Female ..	Early pregnancy in right horn.
,, ..	51*	39·2	,, ..	Lactating with young in breast (56); again early pregnancy in left horn.
,, ..	52	36·0	,, ..	Lactating; left horn post-partum. Young lost.
,, ..	53	34·0	,, ..	Lactating; left horn post-partum.
,, ..	54	28·0	,, ..	Non-pregnant.
,, ..	55	31·0	Male ..	Adult.
,, ..	56	12·0	,, ..	Young from Sp. No. 51.
30-10-1949 ..	57*	36·2	Female ..	Lactating with young (60); again early pregnancy in right horn.
,, ..	58	43·2	,, ..	Advanced pregnancy in left horn.
,, ..	59	42·3	,, ..	Mid-pregnancy in right horn.
,, ..	60	10·8	,, ..	Young from breast of Sp. No. 57.
,, ..	61	18·6	,, ..	Young; mother escaped.
November:				
8-11-1948 ..	31	31·0	Female ..	Non-pregnant.
,, ..	32	26·4	,, ..	Non-pregnant.
,, ..	33	32·6	Male ..	Adult.
10-11-1947 ..	8	46·1	Female ..	Advanced pregnancy in left horn.
,, ..	9	40·2	,, ..	Early pregnancy in right horn.
,, ..	10	37·2	,, ..	Early pregnancy in left horn.
,, ..	11	36·0	,, ..	Lactating with young; young lost. Post-partum horn on left side.
,, ..	12	32·0	Male ..	Adult.
,, ..	13	29·2	Female ..	Non-pregnant.
12-11-1952 ..	127*	..	,, ..	Lactating with young (130); again early pregnancy in left horn.
,, ..	128	..	,, ..	Lactating female, young lost.
,, ..	129	..	,, ..	Lactating female, left horn post-partum young lost.
,, ..	130	..	,, ..	Young from breast of Sp. No. 127.
,, ..	131	..	,, ..	Non-pregnant.
,, ..	132	..	Male ..	Adult.
24-11-1949 ..	62	44·6	Female ..	Advanced pregnancy in right horn.
,, ..	63	12·3	,, ..	Young female. Mother escaped.
28-11-1952 ..	MM	..	Male ..	Adult.
,, ..	WW	..	,, ..	Adult.

Collection diary of Taphozous longimanus (*Hardwicke*)

APPENDIX—*Contd.*

Date of collection	Sp. No.	Body weight in gms.	Sex	Particulars
December:				
5-12-1948 ..	34	46·5	Female ..	Advanced pregnancy in right horn.
,, ..	35	37·2	Male ..	Adult.
8-12-1952 ..	133*	..	Female ..	Lactating with young at breast; again early pregnancy in right horn.
,, ..	134	..	,, ..	Early pregnancy in left horn.
,, ..	135*	..	,, ..	Lactating with young in breast; again early pregnancy in right horn.
,, ..	136	..	,, ..	Young female from breast of Sp. No. 133.
,, ..	137	..	Male ..	Adult.
,, ..	138	..	,, ..	Young from the breast of Sp. No. 135.
12-12-1952 ..	De(i)	36·0	Female ..	Lactating female.
,, ..	De(ii)	37·5	,, ..	Lactating female.
,, ..	De(iii)	38·0	Male ..	Adult.
,, ..	De(iv)	24·2	,, ..	Adult.
,, ..	De(v)	37·0	,, ..	Adult.

Foot note:—

The word 'Adult' has been used in the diary to denote those specimens which were not attached to the breasts of the mothers, as against the word 'Young' which were attached to the breasts of the mothers.

Specimens marked with an asterisk were lactating females which showed on dissection that one of the uterine horns had again become pregnant.

'Non-pregnant female' denotes females which were free and did not show either pregnancy or lactation.

TABLE I

Summary of collection diary

Month	Females				Males			Total
	Pregnant		Non-pregnant		Immature	Adult	Immature	
	Lact.	Non-lact.	Lact.	Non-lact.				
January ..	1	3	1	1	1	3	..	10
February ..	1	4	0	2	2	5	..	14
March ..	2	8	1	1	1	3	1	17
April ..	No Collections							
May ..	No Collections							
June ..	1	3	2	1	2	1	1	11
July ..	..	1	1	3	1	2	..	8
August ..	1	15	2	..	2	2	1	23
September	4	11	4	1	5	12	2	39
October ..	3	12	5	3	2	4	2	31
November..	1	4	3	4	2	3	2	19
December	2	2	2	..	1	5	1	13
TOTAL ..	16	63	21	16	19	40	10	185

8. Explanation of Plates

(All figures are microphotographs)

Fig. 1. Section of the ovary of a juvenile specimen showing the presence of a large number of primordial follicles in peripheral part of the ovary. The central part of the ovary contains a number of unilaminar follicles. ×55.

,, 2. Enlarged part of the surface of the juvenile ovary. One of the cells in the germinal epithelium is large (arrow) and this is the forerunner of the oocyte. Below the surface are found a few of the primordial follicles with flattened satellite cells. ×650.

,, 3. Central part of the juvenile ovary. ×240.

,, 4. Section of the left ovary of a non-parous specimen in its first oestrous cycle. ×40.

,, 5. Central part of the ovary of a specimen in early pro-oestrum. ×110.

,, 6. Ovary of specimen in early pro-oestrum (entire). ×40.

,, 7. Fully formed graafian follicle. ×120.

,, 8. Ovary with corpus luteum in a specimen which had a blastocyst in the uterus of the same horn. ×25.

,, 9. Right ovary of the specimen whose left ovary is shown in fig. 4. ×40.

,, 10. Ovary with a fully developed corpus luteum in a specimen showing advanced pregnancy. ×40.

,, 11. Ovary of the non-pregnant side of a specimen showing early pregnancy in the opposite horn of the uterus. Note the degenerating corpus luteum. ×35.

,, 12. Ovary of the non-pregnant side of a specimen which had advanced pregnancy in the opposite uterine horn. ×50.

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