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Reproductive Cycle of the Female *Rattus rattus brunneusculus* (Hodgson), a Common Field Rat of Mizoram

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Observations on reproductive cycle of the female *Rattus rattus brunneusculus* collected every month from the fields of Mizoram during the period 1977 to 1979 are presented. Changes in the weight and histology of the ovaries of adults during different months of the year reveal that like the male, the female of this species is also a seasonal breeder. The breeding season was found extending from March to December and a short non-breeding phase occurred during January and February. Monthly average number of corpora lutea per pregnant female was found almost corresponding with the number of live fetuses or suckling young ones, indicating very little post-implantation and post-parturition mortality. The number of fetuses per female and percentage of the pregnant ones in the total population of adult females were found to be related with the age. Maximum number of fetuses was observed in the youngest group, whereas, the middle age group showed highest percentage of pregnant females.

Key Words: Field rat, *Rattus rattus brunneusculus*, **Reproductive biology**

Introduction

Rattus rattus brunneusculus (Hodgson) is a common field rat of Mizoram in North-eastern India. This is one of the most economically important species which inflicts great loss to paddy and vegetable crops and stored grains. The male of this species is a seasonal breeder and shows breeding activity for a greater part of the year (March to October) with peaks during June and September, whereas, the non-breeding phase is restricted from November to February (Chauhan & Saxena 1985). The present report deals with the annual reproductive cycle of the female rat based on the occurrence of pregnancy, number of fetuses and litter size.

Materials and Methods

Female rats, *Rattus rattus brunneusculus* were collected live by digging their burrows and also by trapping in crop fields (jhums) and adjoining forests in Mizoram from January 1977 to March 1979. Females weighing more than 45 g and having a head-tail length of more than 28 cm with well developed mammary glands and vaginal opening were

considered as adults. These females were then further classified into non-pregnant, pregnant and lactating groups. The non-pregnant adult females were autopsied every month and the ovaries were removed, weighed and fixed in Bouin's fixative for histological study. Sections were cut at 5–6μm and stained with Haematoxylin and Eosin.

The percentage of subadults and adults in monthly catches was also calculated. Record of the number of live fetuses and corpora lutea was maintained. For distribution of pregnancies in females of different age groups, the weights of the pregnant animals were taken exclusive of the foetal weights. The number of young ones collected from each nest present in burrows was also recorded.

Table 1 *Occurrence of non-pregnant adult, pregnant and lactating female rats during different months*

Month	Number of animals	Non-pregnant (%)	Pregnant (%)	Lactating (%)
January	98	100.0	—	—
February	103	95.9	4.1	—
March	67	93.0	7.0	—
April	44	64.3	21.4	14.3
May	97	50.0	16.7	33.3
June	86	47.1	35.3	17.6
July	61	36.4	18.2	45.4
August	74	37.5	34.5	28.0
September	139	35.0	25.0	40.0
October	92	60.0	20.0	20.0
November	134	48.7	24.4	26.9
December	108	66.7	11.0	23.3

Results

Subadult Females

Though subadult females were found throughout the year, their percentage in the total population of females varied in different months. It was low in February (2.7%) and March (2.5%) but subsequently started increasing and showed high values from April to August (15% to 25%), which reached a maximum during October to December (48.7% to 53.8%).

Adult Females (table 1)

Non-pregnant: These females were found throughout the year but their number was extremely high from January to March (93% to 100%). Subsequently, with the increase in number of pregnant females, their number started decreasing and became considerably low during July to September (35% to 37.5%). Once again, their number became relatively high from October to December.

Pregnant: Pregnant females were not found in January, however, they started appearing from February onwards. Their number gradually increased and attained a maximum in June (35.3%). In July, their number decreased (18.2%) but again increased in August (34.5%).

Lactating: No lactating females were found from January to March but with their appearance in April, their number showed variation in the later months. It was relatively high in May (33.3%), September (40%) and October (23.3%) and highest in July (45.4%).

Cyclic changes in ovary: The following monthly observations were made in the ovaries of sexually mature non-pregnant females.

Weight (mg/100g body weight, figure 1):

The ovarian weights were low during December to February, being lowest in January (4.82mg). They showed a significant increase in March (9.48mg, $P<0.001$) and as a result of further increase, ovarian weights ranged from 12.54 to 20.04mg from April to November.

Histology (figure 3A, B): The ovaries of the females caught from March to November showed typical breeding characteristics with

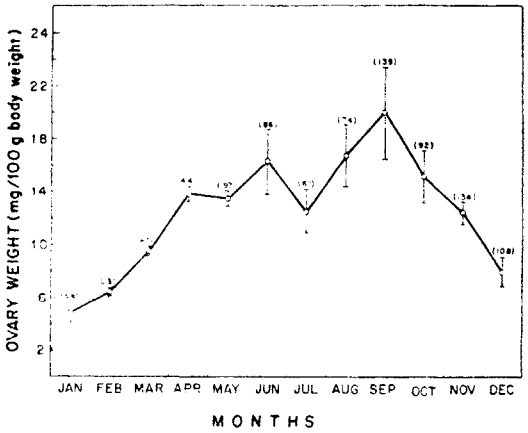

Figure 1 Monthly changes in ovarian weight in adults. Each point represents the mean value and the vertical lines show SEM. The figures in parenthesis indicate the number of animals used

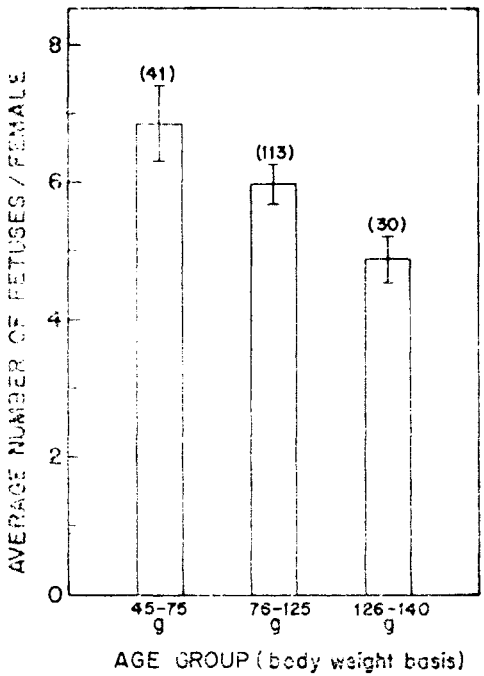

Figure 2 The average number of fetuses in relation to the weight group of the mother. The vertical lines show SEM and the figures in parenthesis indicate the number of pregnant females

active folliculogenesis. Such ovaries contained fully formed Graafian follicles and other follicles at different stages of development. Few atretic follicles were also seen. Functional corpora lutea along with one or two degenerating ones were also observed. The ovarian stroma was less dense but well vascularized. The stromal cells were large and polyhedral with distinct boundaries; the nuclei were densely stained, while the cytoplasm was light and vacuolated.

From December to February, ovaries showed anoestrus condition. Only partially developed follicles were observed and Graafian follicles or functional corpora lutea were absent. In some cases, few regressing corpora lutea were also observed. The number of atretic follicles showed an increase. The stroma was very dense with indistinct cells.

Number of live fetuses, corpora lutea and suckling young ones (table 2): No significant difference was observed in the average number of live fetuses in gravid females during different months which varied from 5.5 to 6.5. Similarly, no difference was seen in the average number of corpora lutea per female (range 6.0 to 8.0), though these were slightly more as compared to average number of live fetuses. Average number of suckling young rats collected from each nest occupied by a single mother ranged from 5.0 to 6.5. These values were almost same as the number of live fetuses.

Age vs. incidence of pregnancy and number of fetuses (figure 2): Distribution of pregnancies in females of different age groups showed a specific correlation. Maximum number of pregnant females belonged to middle age group (76–125g), which was more than double the number of pregnant females in the lower age group (45–75g) and three times more than in the higher age group (126–140g).

The number of fetuses also showed a relationship with the age of the mother. The average number of fetuses was maximum

Table 2 *Number of live fetuses and corpora lutea in pregnant rats and the number of young ones per nest during different months* (Mean ± SEM)

Month	Number of pregnant females	Average number of live fetuses per female	Average number of corpora lutea per female	Number of nest observed	Average number of young per nest
January	—	—	—	—	—
February	—	—	—	—	—
March	5	6.2 ± 0.58	7.0 ± 1.50	8	5.0 ± 1.00
April	9	6.0 ± 0.89	6.6 ± 0.65	15	5.5 ± 0.76
May	16	6.0 ± 1.00	7.5 ± 0.35	8	6.5 ± 0.89
June	30	6.2 ± 0.34	6.8 ± 0.76	19	6.0 ± 0.50
July	11	5.5 ± 0.50	7.5 ± 0.50	5	6.0 ± 0.41
August	25	6.3 ± 0.33	7.0 ± 1.50	4	6.0 ± 1.23
September	35	5.5 ± 0.41	8.0 ± 1.00	7	7.5 ± 0.33
October	18	5.5 ± 0.50	6.0 ± 0.50	4	5.0 ± 1.50
November	33	6.0 ± 1.26	6.7 ± 1.23	12	5.7 ± 0.65
December	12	5.8 ± 1.00	6.3 ± 1.45	17	5.8 ± 0.89

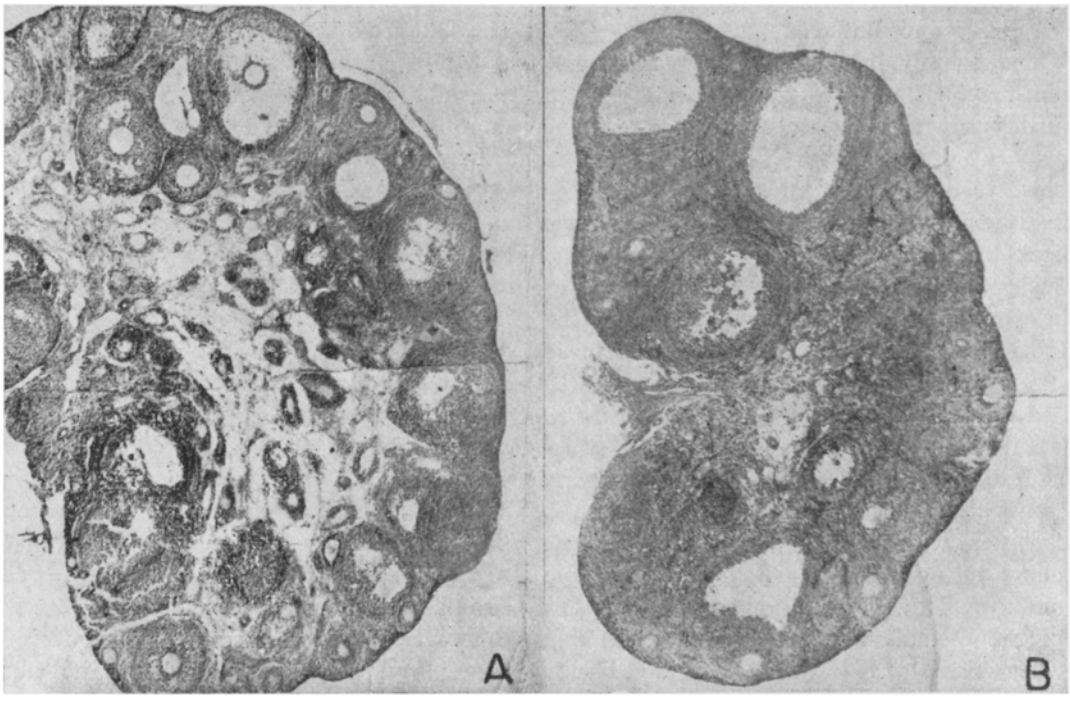

Figure 3 T S of ovary. **A**, breeding phase (×40); **B**, non-breeding phase (× 40)

(6.87) in the lowest age group and decreased with the increase in age of the mother.

Discussion

The female field rat, *R. r. brunneusculus*, like the male, is a seasonal breeder. Monthly observations on the changes in the weight and histology of the ovary suggested that the sexual activity extends from March to November, while the sexually inactive or anoestrus phase is rather short and restricted to winter months (December to February). The breeding cycle of this field rat is comparable to that of the females of many other rodent species (Wade 1927, Foster 1934, MacMillen 1964, Horner & Taylor 1968, Srivastava 1968, Seth & Prasad 1969, Prakash 1975, Guraya & Gupta 1977) which show either identical or a shorter period of sexual activity. The ovary during the breeding and non-breeding phases in *R. r. brunneusculus* shows histology similar to those previously reported in other seasonally breeding rodents.

The monthly distribution of subadult, adult non-pregnant, pregnant and lactating females further provides support for seasonal breeding activity in this species of the field rat. The presence of relatively high number of pregnant females in June and August indicates peak breeding activity during these months. Such peaks in the breeding activity have also been reported for other rodents like the Indian desert gerbil, *Meriones hurrianae* (Prakash 1964, Kaul & Ramaswamy 1969) and north Indian gerbil, *Tatera indica indica* (Jain 1970). The non-availability of pregnant and lactating females in January clearly shows absence of breeding activity which is consistent with the occurrence of non-breeding phase during this and subsequent one or two months. However, the occurrence of a few pregnant females during February and March, when the majority of the animals are sexually inactive, is not of much significance and may be due to the premature onset of breeding in some animals.

Occurrence of lactating females from April to December with a peak in July and September is probably due to high rate of littering during these months; this seems to be reasonable since a high percentage of pregnant females was observed in the months preceding to these peaks. The non-pregnant adult females occur throughout the year but are more numerous during January and March. The number of these animals from July to September is comparatively low which may be due to the fact that large number of mature females are either pregnant or lactating at this time.

The subadult females are found throughout the year but their significant increase from April to January and then fall in number during February and March confirms that this species is a seasonal breeder. The subadults which are found in February and March may be the result of stray cases of deliveries in these or in previous months. The significant increase in the percentage of subadults from September to December indicates intense breeding a few months after the onset of the actual breeding phase.

In contrast to the situation prevailing in some seasonally breeding temperate and tropical animals, especially birds, the role of any particular environmental factor in regulating the reproductive cycle is not evident. Low temperature or short photoperiod during winter months (December to February) could possibly be detrimental or a blocking factor to breeding activity. Everett (1972) also reported that in winter months many female rats become infertile. Besides environmental factors, the availability of food may also have some regulatory effect on the breeding cycle. Animals are normally sexually active at the time when the food in some or other form is readily available in the fields. The non-breeding phase generally coincides with the period when the fields are barren and there

is an overall scarcity of food. However, in the absence of any concrete evidence it is rather difficult to implicate any factor(s) in the regulation of the annual reproductive cycle of this rat species.

The average number of live fetuses (5.5 to 6.5) in pregnant females during different months did not show any significant difference though individual variations were noticeable in the number of fetuses which varied from 2 to 10 fetuses per female. This is similar to the reports in other species of rats and mice (Brambell 1956, Taylor 1961, Asdell 1964); however, in some rodent species, even the monthly variations in the average fetus count have been reported (Prasad 1961, Kaul & Ramaswamy 1969). The individual variations in the number of fetuses seem to be related with the age. With the increase in age there is corresponding decrease in the number of fetuses indicating gradual decrease in productivity. However, the maximum number of pregnant females belong to middle age group which suggests that in contrast to fetal count, the breeding activity increases with age upto a certain limit and then declines. An interesting observation was that the average number of live fetuses is very close to the average number of functional corpora lutea or young ones collected from each nest occupied by a single female. This clearly indicates an extremely low rate of pre- or post-natal mortality in contrast to that reported in some species of the family Cricetidae (Beer et al. 1957, Prasad 1961).

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Refcrences

Asdell S A 1964 *Patterns of Mammalian Reproduction* (2nd edn) pp 213–409 (London: Constable and Co. Ltd.)

Beer J E, Macleod C R and Frenzel L D 1957 Prenatal survival and loss in some cricetid rodents; *J. Mammal.* **38** 392–402

Brambell F W R 1956 Ovarian changes; in *Marshall's Physiology of Reproduction* (3rd edn) Vol. I Part I pp 397–542 ed. A S Parkes (London: Longmans, Green and Co Ltd.)

Chauhan N S and Saxena R N 1985 Annual reproductive cycle of the male field rat, *Rattus rattus brunneusculus* (Hodgson) in hilly terrain of Mizoram; *J. Bombay Nat. Hist. Soc.* (in press)

Everett J W 1972 Brain pituitary gland and the ovarian cycle; *Biol. Reprod.* **6** 3–12

Foster M A 1934 The reproductive cycle in the female ground squirrel, *Citellus tridecemlineatus* (Mitchill); *Amer. J. Anat.* **54** 487–511

Guraya S S and Gupta S 1977 Observations on the reproductive biology of the soft-furred rat, *Millardia meltada; Proc. All India Rodent Sem.*, Ahmedabad pp 70–75

Horner B E and Taylor J M 1968 Growth and reproductive behavior in the southern grasshopper mouse; *J. Mammal.* **49** 644–660

Jain A P 1970 Body weights, sex ratio, age structure and some aspects of reproduction in the Indian gerbil, *Tatera indica indica* (Hardwicke) in the Rajasthan desert, India; *Mammalia* **34** 415–432

Kaul D K and Ramaswamy L S 1969 Reproduction in the Indian desert gerbil, *Meriones hurrianae* (Jerdon); *Acta Zoologica* **50** 233–248

MacMillen R E 1964 Population ecology, water relations and social behaviour of a southern California semi-desert rodent fauna; *Univ. Calif. Publ. Zool.* **71** 1–59

Prakash I 1964 Eco-toxicology and control of Indian desert gerbil, *Meriones hurrianae* (Jerdon). Part II. Breeding season, litter size and post-natal development; *J. Bombay Nat. Hist. Soc.* **61** 142–149

—— 1975 The population ecology of the rodents of the Rajasthan desert, India; in *Rodent in Desert Environment* pp 75–186 eds. I Prakash and PK Ghosh (The Hague: Dr W Junk b.v. Verlag Publishers)

Prasad M R N 1961 Reproduction in the female Indian gerbille, *Tatera indica cuvierii* (Waterhouse); *Acta Zoologica* **32** 245–256

Seth P and Prasad M R N 1969 Reproductive cycle of the female five-striped Indian palm squirrel, *Funambulus pennanti* (Wroughton); *J. Reprod. Fertil.* **20** 211–222

Srivastava A S 1968 *Rodent Control for Increased Food Production*; 1–152 (Kanpur: Rotary Club (west)),

Taylor J M 1961 Reproductive biology of the Australian bush rat, *Rattus assimilis; Univ. Calif. Publ. Zool.* **60** 1–66

Wade O 1927 Breeding habits and early life of the thirteen-striped ground squirrel, *Citellus tridecemlineatus* (Mitchill); *J. Mammal.* **8** 269–276