THE BREEDING SEASON OF THE MULTIMAMMATE MOUSE *PRAOMYS* (*MASTOMYS*) *NATALENSIS* (A. SMITH) IN THE TRANSVAAL HIGHVELD

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INTRODUCTION

The multimammate mouse is one of the commonest and most widespread rodents in Africa. Not only is it an agricultural pest during periods of population explosions but, partly because of its semi-domestic habits, it also plays an important rôle in the spread of plague in Africa.

Brambell and Davis (1941) showed that in the Sierra Leone multimammate mouse a possible correlation existed between rainfall and breeding season. A relationship between breeding season and rainfall was also found by Pirlot (1954) in Katanga, and by Chapman, Chapman & Robinson (1959) in the Rukwa area of Tanganyika. These studies all indicate a short break in breeding during the dry season.

MATERIAL

The multimammate mice that form the subject of the present study were dug out in the Roodepoort district where rodent eradication is being done as part of the normal anti-plague campaign. The collection area covers about 10 sq. miles. The mice that were collected were sent alive to the Medical Ecology Centre every week for a period of 20 months from March 1960 until October 1961.

A total of 4,636 mice were weighed comprising 2,199 males and 2,437 females. Of these 398 males and 481 females were dissected and 794 skulls cleaned.

METHODS

The mice were weighed and sexed. Those intended for dissection were etherised, their total and tail lengths measured and the appearance of the mammae and vulva noted in the females. The gut (*i.e.* from the lower oesophagus to the rectum, including the spleen but not the liver) was removed and weighed.

The paired uteri and ovaries of the females were removed and spread out to check for the presence of small embryos and/or placental sites. They were recorded as: pregnant, *i.e.* when visibly pregnant; parous with placental sites present; parous without placental sites, in which

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case the uteri were vascularised with a greater diameter than in immature animals and sometimes suffused with blood capillaries; or non-parous with the uteri unvascularised and not pregnant.

The uteri were sometimes distended and filled with a translucent fluid. This condition occurs during the oestrous. Females were taken as being in their first oestrous when the uterine walls were thin with placental sites absent. Placental sites were not easily detected in the presence of large embryos.

The paired testes, vesiculae seminales (with the antero-dorsal lobe of the prostate) and later on also the caudae epididymides were removed and weighed. The presence of sperms in the cauda epididymis was confirmed microscopically. The relative abundance of sperms was taken as being either absent (nil); with only a few sperms visible amongst fat globules (+); more sperms present but still scattered on the slide between membranes of the epididymis (++); or sperms present *en masse* with hardly any or no other recognisable material (+++). The animals with (++) and (+++) sperm ratings were taken as being fecund while those with a few sperms were classed as unfecund. With abundant sperms present the coils of the tubules of the epididymis were clearly visible and microscopic examination was not necessary. Determining the presence of sperms in the cauda epididymis is more convenient for rapid routine examination than examining the testis and there is presumably no difference in the final fecundity rating of the animal. In the gerbil *Tatera indica*, Prasad (1956) found that sperms appear more or less simultaneously in both these organs.

The skulls of the dissected mice were cleaned and their degree of toothwear determined as a criterion of relative age. The toothwear groups used by Davis (1959) were basically followed. Seven groups were recognised, indicated by the symbols O and I to VI.

RESULTS

Sex ratio

Females formed 53·2 per cent of the total collection. As shown in Table I the largest proportion of females was present during the spring. A slight preponderance of females was also found in the number of young born in captivity as reported by Oliff (1953) (0·519 females) but not in Meester's (1960) study which had an 0·54 male ratio.

Females

Body-weights and breeding stages

The scatter diagram, Fig. 1, showing the gross body-weights of females throughout the year indicates a continuous period of moderate breeding from August onwards, throughout the summer, reaching a peak in April. This is followed by a non-breeding period starting in the latter half of May and continuing through June and July. Only one pregnancy was recorded for June and two for July out of a total of 82 adult females autopsied; the corresponding numbers for April were 43 pregnant females out of a total of 76 autopsies. It must be noted, however, that a large number of non-lactating females with placental sites were recorded throughout this quiescent period. As placental sites in the uteri of multimammate mice heal remarkably soon after parturition (Brambell & Davis 1941) these parous females could be regarded as anoestrous animals which had been breeding during the previous months.

From a laboratory study by Johnson & Oliff (1954) we know that a post-partum oestrous occurs in multimmamate mice and if no implantation occurs an anoestrous period follows during lactation. Non-pregnant, non-lactating from the field with placental sites could thus be regarded as being anoestrous or may even be post-breeding animals shortly after their last parturition; and those which are parous but without placental scars could be post-breeding animals. Specimens autopsied during early pregnancy might be classed erroneously under one of the above groups.

Monthly embryo count

The number of embryos per litter is shown in Fig. 2 for the different months and for the total collection. Unfortunately only five adult females were collected during January and one during February. The low embryo record (four during January and none during February) is thus misleading and it most likely gives an inaccurate picture of late summer breeding. The low embryo counts during June (six) and July (two recorded but only one counted with two embryos), however, give a true indication of the actual position.

TABLE 1: MONTHLY NUMBER OF FEMALES DISSECTED AND THE PERCENTAGE OF FEMALES COLLECTED

MONTH	FEMALES DISSECTED				SPECIMENS WEIGHED	
	Total	No. of adults	No. of adults pregnant	Percentage of adults pregnant	Total no. weighed	Percentage females
January	6	5	4	90·0	79 (January–February)	48·1 (January–February)
February	1	1	1	100·0		
March	40	32	10	31·3	232	51·7
April	80	78	43	55·2	525	53·1
May	80	65	15	23·1	766	52·1
June	64	37	1	2·7	956	51·2
July	55	47	2	4·3	846	52·8
August	60	50	8	16·0	681	52·3
September	41	19	5	26·3	245	60·8
October	25	17	8	47·1	175	58·3
November	18	18	14	77·8	175	62·3
December	11	9	4	44·4	59	54·2
Totals	481	378	115	30·4	4,739	53·17

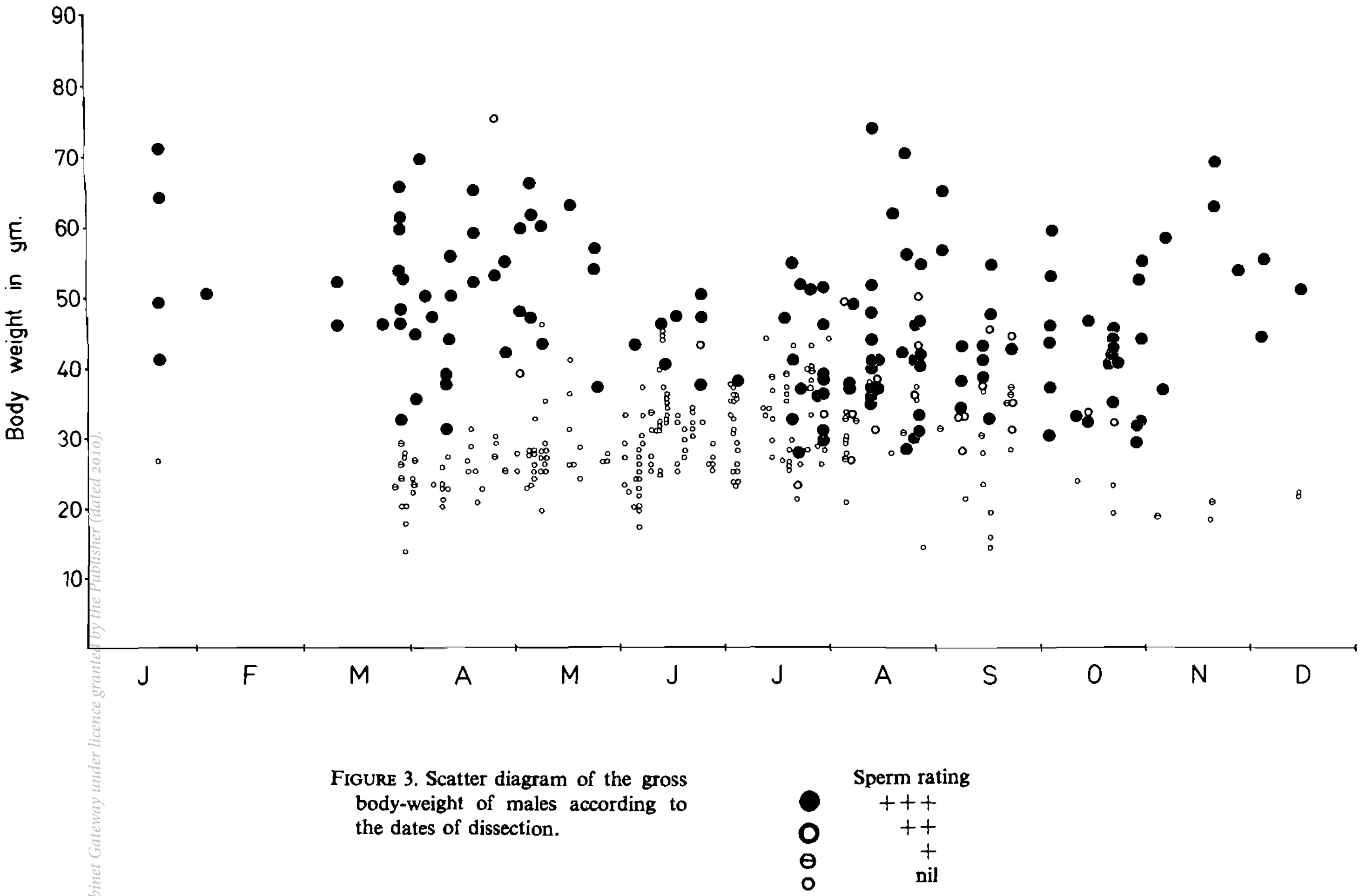

FIGURE 3. Scatter diagram of the gross body-weight of males according to the dates of dissection.

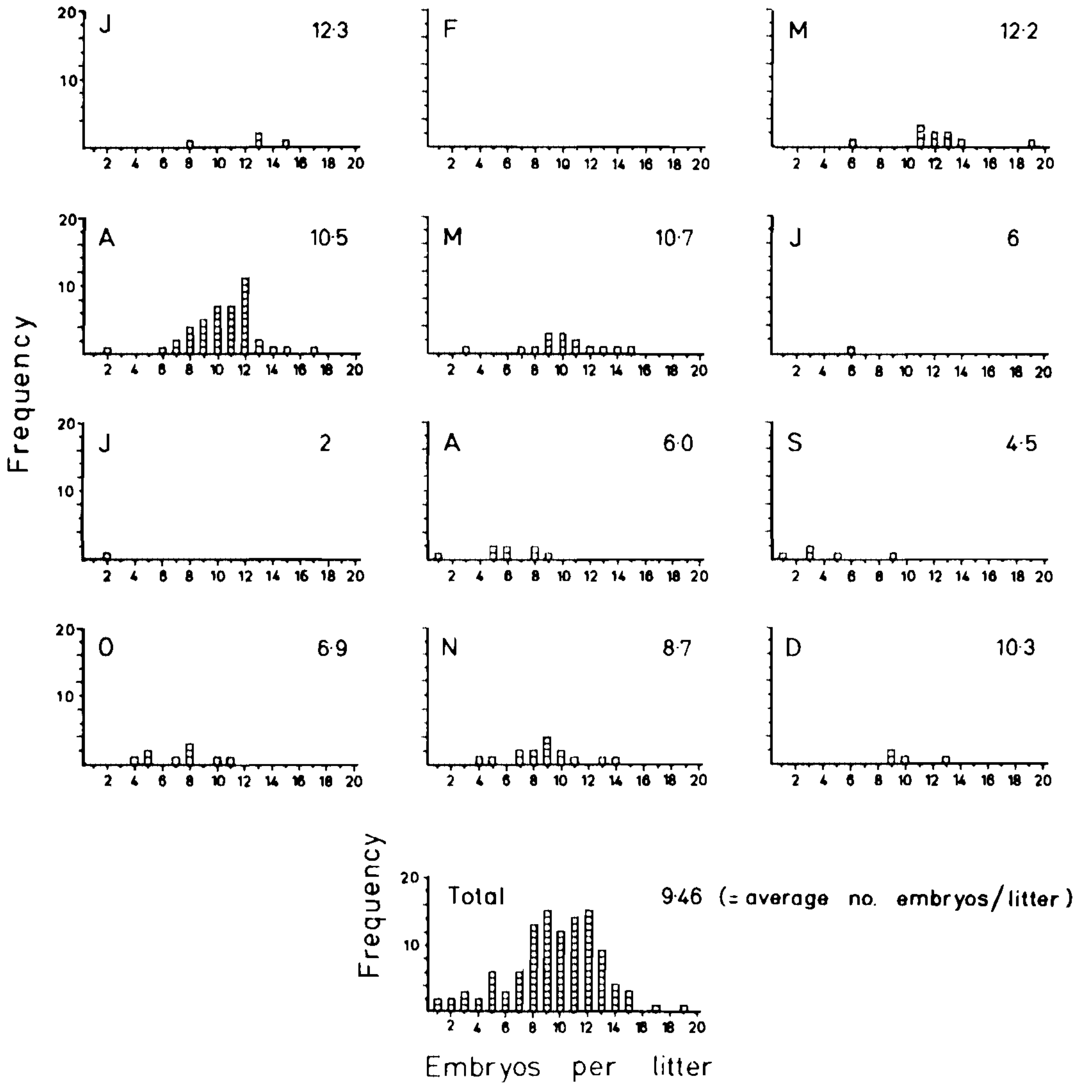

FIGURE 2. Frequency polygons showing the number of embryos per litter for the different months.

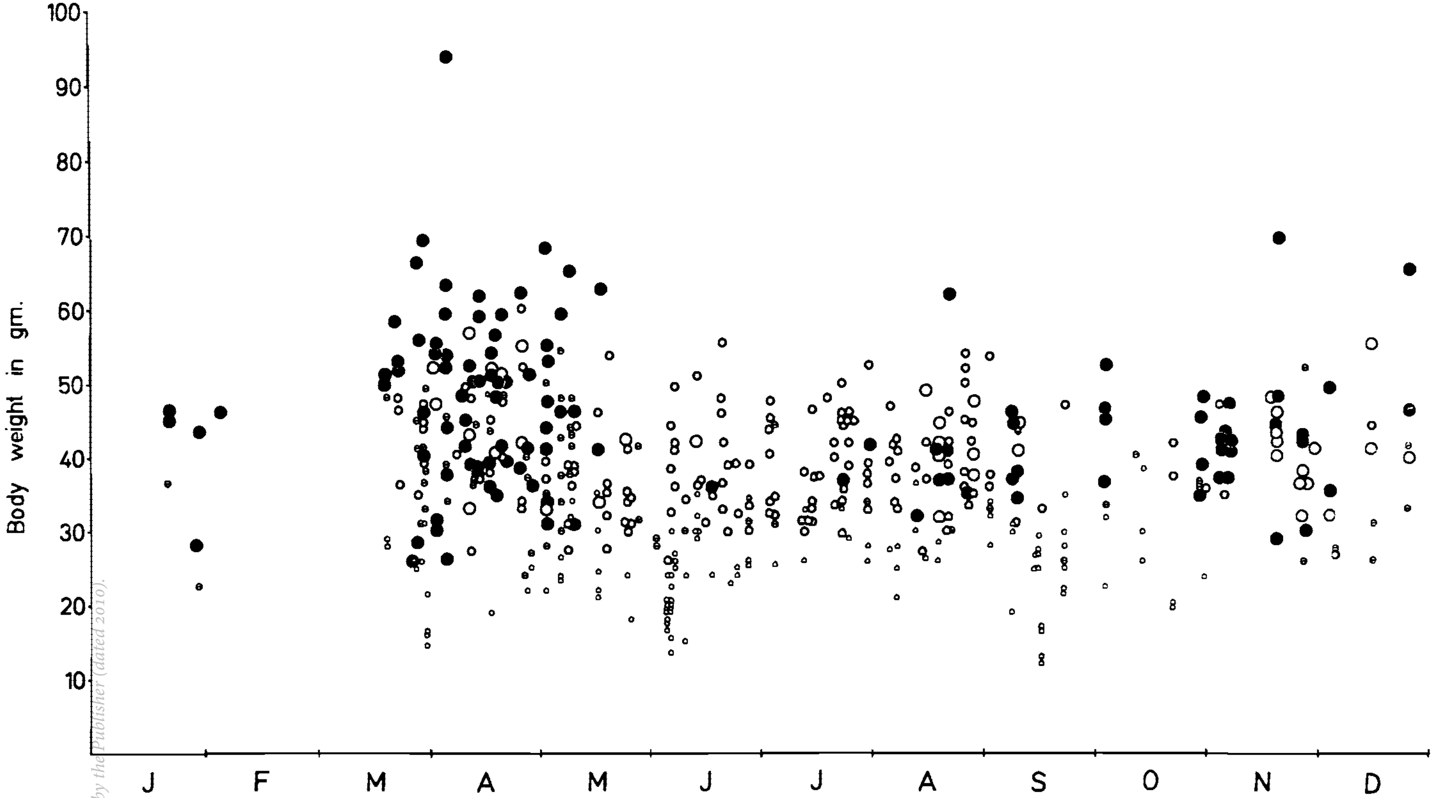

FIGURE 1. Scatter diagram of the gross body-weights of females according to the dates of dissection.

Pregnant females

lactating females

parous with placental sites

non-pregnant, parous without placental sites *or* non-parous in first oestrous

non-parous, juvenile specimens

The combined graph for frequency of embryos per pregnancy showed that the usual range was 5 to 12. During April the number of embryos per female increased from one record with 6 embryos to 11 records with 12 embryos dropping to only two records with 13 embryos. The largest number of embryos per female, 19, was recorded during March.

As only those pregnancies that were sufficiently advanced to be recognisable with the naked eye were used, the total number of embryos recorded is actually too low. This error is presumably consistent and may be ignored when comparing the figures for the different periods.

A total of 1,078 embryos was recorded from 114 pregnant females (mean 9·46 embryos per litter). The mean number of embryos at Rukwa was 11·2 (range from 3 to 16) for 10 females (Chapman *et al.* 1959) and 11·8 (range from 7 to 17) in Sierra Leone (Brambell & Davis 1941), while Oliff (1953) obtained a mean litter size of 7·2 in a laboratory colony.

Males

Body-weights and breeding stages

An indication of a period of low fecundity during the winter months (late May, June and early July) appears in the scatter diagram, Fig. 3, where the fecund and non-fecund males were plotted against the time of the year and their gross body-weights.

Breeding activity of the males, as deduced from the presence of sperms in the epididymides, extends mainly from late July to May with a less active period during June and early July. This period of quiescence is not as distinct as that of the females.

A few post-breeding males in different stages of regression were recorded. Brambell & Davis (1941), however, did not find any signs of regression in males collected at Freetown.

Comparative weights of testes and vesiculae seminales

In Fig. 4 the weights of testes and vesiculae seminales are compared. The different symbols show the sperm rating as in Fig. 3. Each of the graphs in Fig. 4 except the last one represent a full month taken from the 16th day of one calendar month to the 15th day of the next.

In the period July–August testes weights formed a more or less continuous series with low vesiculae seminales weights. The maximum vesiculae seminales weights increased during the following months. Testes weights fall into two groups from October–November onwards to April–May when the grouping is most prominent. During the period May–June testes weights are, as is the case with body-weights, relatively low although vesiculae seminales weights are still comparable with those of the previous two periods. This could be due to atrophy of the testes before the vesiculae seminales regress as is shown in specimen No. PL 61.19:23, autopsied 8 May 1961, which had the following characteristics: gross body-weight 46 g. with testes hard and milky-white having the appearance of being partly calcified, weighing only 0·75 g.; no sperms in the epididymis; the vesiculae seminales apparently normal, weight 0·58 gm. toothwear group V.

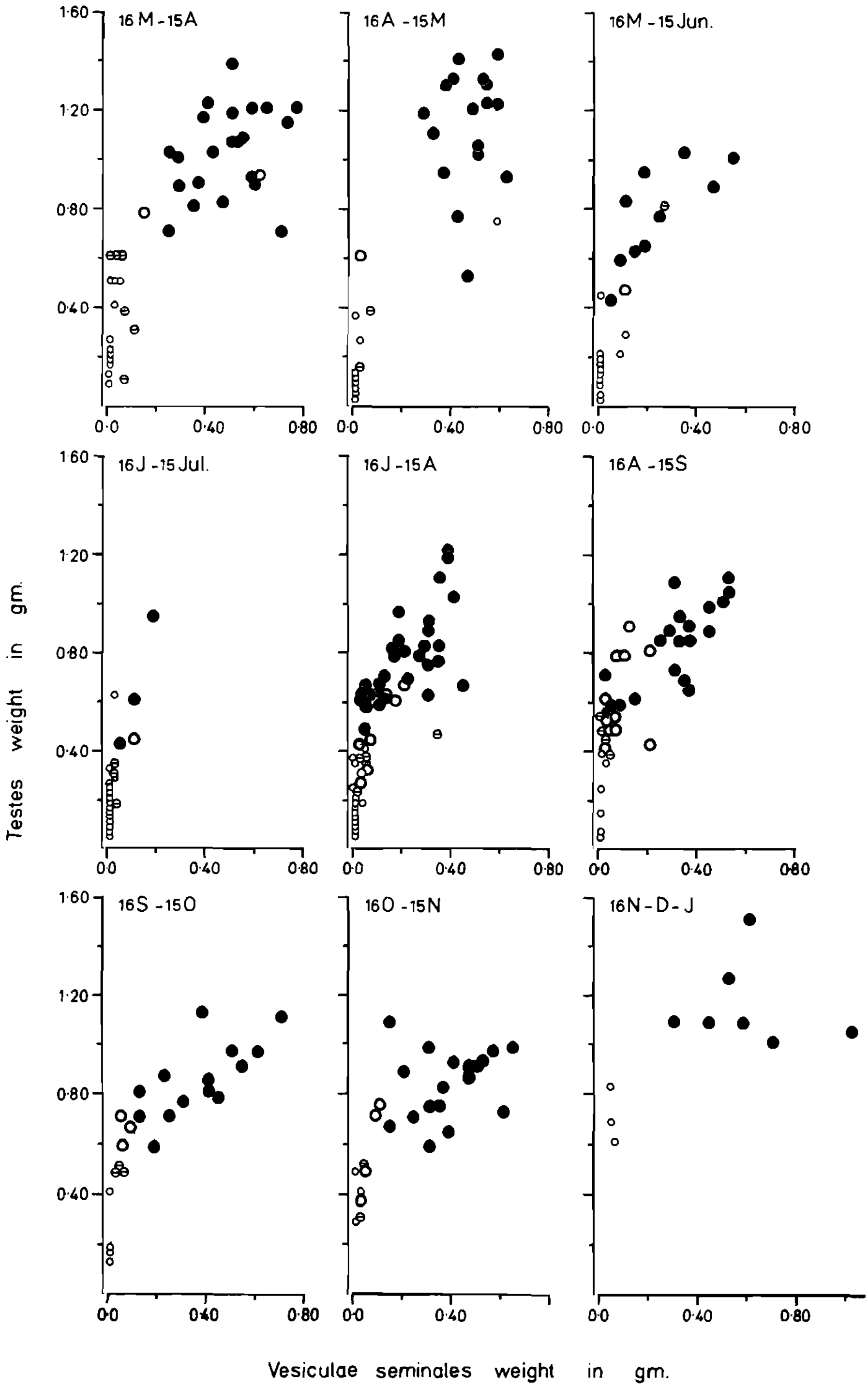

FIGURE 4. Weights of the paired testes compared with those of the vesiculae seminales. Symbols as in the male scatter diagram, Figure 3.

Toothwear as a criterion of age

The specimens with known degree of toothwear represent only a small proportion of the total number weighed; this is not a truly representative sample of the collection because mainly larger animals were dissected. To compensate, a comparable number of undissected young animals (below 25 gm.) was brought into the calculations by using a proportionate number of older animals with known toothwear as a basis.

The group of mice with weights less than 15 gm. were regarded as having 0̄-wear and the 15 to 25 gm. group as having I-wear. Fig. 5 combines the calculated data for low body-weight and the toothwear. The width of each polygon at the intersection of the wear-line represents the proportion of the sample falling in that toothwear group.

In the December to early August polygons a decrease in numbers of 0̄-wear animals (*i.e.* up to weaning age) can be noticed, with a corresponding increase in the I-wear group (*i.e.* weaning to pubertal age). From August onwards 0̄-wear was again recorded but while the I-wear group still forms the largest section of the August-September population the II- and III-wear groups are well represented. The III-wear group was as often represented as was the I-wear group in the September–October population. The October–November polygon has III-wear and the following polygon IV-wear as the dominant groups.

The frequency of adult animals decreased considerably from December to the period May–July.

DISCUSSION AND CONCLUSIONS

Both female and male fecundity records indicate a break in breeding during the winter months. The female appears to be the determinant of the breeding cycle. Presuming that the breeding year commenced during July, we may conclude that annual breeding started with a period showing low pregnancy and embryo counts, and built up to a peak in late summer and autumn with a sudden drop in June.

As was to be expected, the more active breeding season of the male started about four

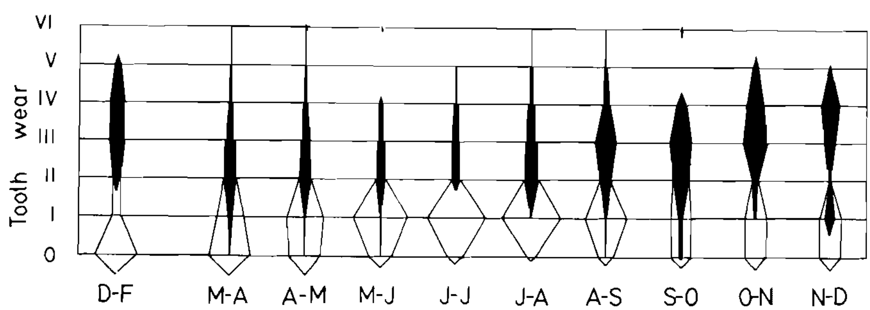

FIGURE 5. The relative age distribution of multimammate mice during different periods. Width of each polygon at the intersection of the wear-line represents the proportion of the sample falling in that tooth-wear group.

weeks before the period in August when a large number of pregnant and lactating females was recorded.

The decrease in maximum body-weights observed, especially in the males, during June and July might be due to the fact that they either underwent a considerable reduction in their body-weights or suffered heavy mortality. It is noteworthy that although climatic conditions during the winter were more severe, the mice in the study area had an abundant food supply in local mealie-lands. These cultivated fields cover about half the total collecting area. Fat tissue in the intestinal cavity was furthermore noticed mainly during the winter months.

Using body-weight as an approximate indication of age, and combining it with toothwear, it can be ascertained that the heavier (older) animals must have died off at the beginning of winter, and furthermore that males born just before the winter reached fecundity at a higher weight level (older age).

The Transvaal Highveld has a summer rainfall season extending from October to April. The multimammate mouse in that area has its main breeding season at the end of the rains and beginning of the dry season. This agrees with the findings of Brambell & Davis (1941) in West Africa where the major breeding period occurred during September to January *i.e.* following the July to September rainy season. This pattern was also found in the multimammate mouse in Rukwa (Chapman *et al.* 1959) and in Katanga (Pirlot 1954).

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SUMMARY

1. Out of 4,636 multimammate mice used in this study (879 dissected) the females were slightly (52·6 per cent) in the majority.
2. Breeding occurred during the greater part of the year, with a break during the dry winter months.
3. At the commencement of breeding in August the pregnancy rate and number of embryos per female was much lower than towards the end of the breeding period.
4. The testes develop and regress before the vesiculae seminales.
5. A combined graph of the degree of toothwear and body-weight shows that subadult animals form the largest part of the late May to early August population.

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