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Population structure and breeding season in *Rattus rattus wroughtoni* Hinton*

S KESHAVA BHAT, A SUJATHA, R ADVANI and A S SUKUMARAN
Central Plantation Crops Research Institute, Kasaragod 670 124, Kerala, India

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Abstract. Observations were made from July 1982 to June 1985 on certain aspects of the population ecology of *Rattus rattus wroughtoni* Hinton. Altogether 2639 specimens of rats were collected. The male to female ratio was 0·87 : 1·0. Male rats were significantly heavier and bigger than the females. Pregnant female rats were encountered throughout the year with two peaks, one during early summer (February–March) and the other during monsoon (July–August). The incidence of pregnancy was lowest in May when the day temperature was maximum. The litter size ranged from 1–8. The pre-implantation loss was 0·75 ovum per female.

Keywords. *Rattus rattus wroughtoni*; sex ratio; body weight; breeding season; litter size; pre-natal mortality.

1. Introduction

Rattus rattus wroughtoni Hinton is the most common murid distributed in the south west India (Ellerman 1961). It is one of the major rodent pests of plantation crops, especially coconut (Advani 1985) and cacao (Bhat 1978; Abraham and Remamony 1979; Bhat *et al* 1981). Observations on its nests and breeding behaviour in captivity (Rajagopalan 1970, 1972) and some aspects on its population and post-natal development (Advani 1984b) were already made. In this communication, we discuss the data collected for 3 years on the population structure and breeding season of *R. r. wroughtoni*.

2. Study area and climate

The study was conducted in the plantations of coconut, arecanut and cacao around Kasaragod (12° 30′ N; 75° E). Other crops such as banana, pineapple, black pepper, jack and mango were also intercultivated. During the rainy season, the undergrowth in the plantations was quite thick with annual weeds, but during summer most of these dried up and the soil surface was relatively devoid of any ground cover. The climatic conditions of this area are given in figure 3.

3. Methods

Monthly collections of live specimens of *R. r. wroughtoni* were made at random, from different plantations during July 1982 to June 1985 using wooden box traps. The trapped animals were removed daily, brought to the laboratory and data collected

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on their sex, body weight and linear measurements of head and body, tail, pinna and hindfoot. The animals were then dissected and the following aspects were studied and record maintained individually. In males the position of the testes (abdominal or scrotal) was noted and smears from the cauda epididymus were examined for the presence of sperms. In females, the embryos and corpora lutea, if present, were counted. The male rat was considered to be reproductively active if the testes were scrotal and sperms present in the smears of its epididymus and the female considered mature if its vagina was perforate (Tamarin 1977). Ovulation rate and litter size were determined from the number of corpora lutea in the ovaries, and implanted embryos in the uteri respectively. Pre-implantation loss was calculated as the difference between the total number of corpora lutea and the embryos in the animals displaying both. Post-implantation loss due to the mortality of implanted embryos was determined by counting the resorbing embryos.

4. Results and discussion

4.1 *Sex ratio*

Out of 2639 specimens of *R. r. wroughtoni* collected 1231 were males and 1408 were females (0·87 : 1·0). This showed a significantly more ($X^2(1) = 11{\cdot}6$; $P < 0{\cdot}001$) number of females in the population. A similar trend was reported in several other populations of *R. rattus* (Iyer 1933; Deoras *et al* 1975; Advani 1984a; Advani and Rana 1984). In *R. rattus* (Ecke 1955; Bently and Taylor 1965), *R. norvegicus* (Davis 1948) and in *R. meltada* (Chandrahas and Krishnaswami 1974) the females were known to persist longer (nearly 1·3 times) than the males in the population. Such difference in longevity in favour of females could be the main reason for the presence of more number of females in the population.

The males outnumbered the females only during March, July and August (figure 1). This could be attributed to the presence of more number of pregnant females during these months as compared to the whole year (figure 2). Barnett and Prakash (1975) established that the movements of female rats were much restricted few days before and after parturition. This restricted movements in females might have reduced the trapping success in females.

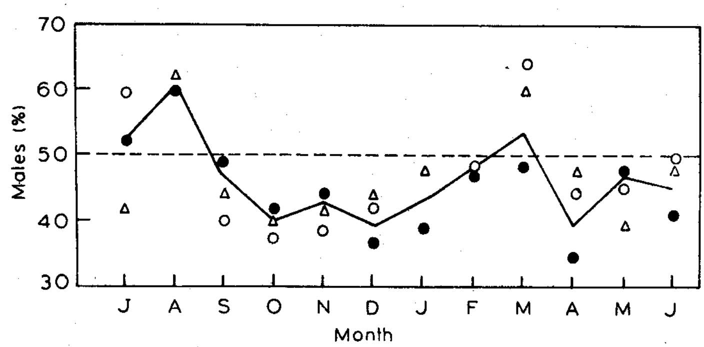

Figure 1. Sex ratio (% of males) of *R. r. wroughtoni* in different months. (●), 1982–83; (○), 1983–84; (△), 1984–85. The line represents the pooled data for 3 years.

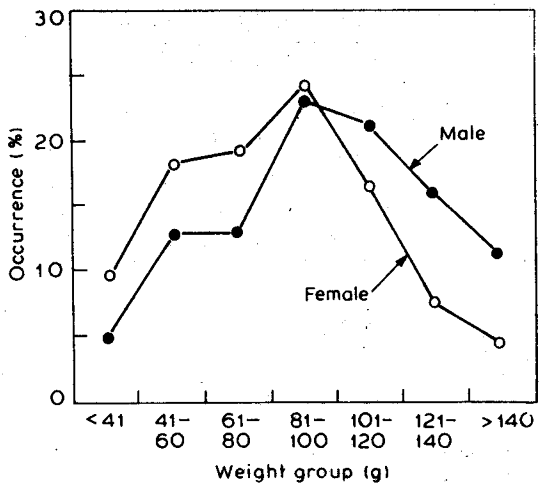

Figure 2. Percentage of occurrence of various weight groups in *R. r. wroughtoni.*

Table 1. Sex ratio of *R. r. wroughtoni* in different weight groups.

Weight group (g)	Sample size	Number		Males (%)	$X^2(1)$	*P* value
		Males	Females			
<41	189	61	128	32·3	23·7	0·001
41–60	420	158	262	37·6	25·7	0·001
61–80	428	160	268	37·4	27·2	0·001
81–100	625	283	342	45·3	5·6	0·05
101–120	495	263	232	53·1	1·9	NS
121–140	273	166	107	60·8	13·6	0·001
>140	209	140	69	67·0	24·1	0·001

When the animals were grouped into separate weight classes (table 1) it was revealed that the female rats were significantly more in number than the males in lower weight classes (< 100 g), whereas the males significantly outnumbered the females in higher weight groups (>121 g). Bently and Taylor (1965) have reported that in *R. rattus* the males gained weight much faster than the females during their development. Thus, the faster weight gain in males might have resulted in the presence of significantly more number of heavier males than females in the population. Chandrahas and Krishnaswami (1974) and Okia (1976) were also of the opinion that in rats the males acquire body weight faster than the females.

4.2 *Body weights*

In general, the male rats were significantly heavier and bigger ($P < 0{\cdot}01$) than the female rats (table 2). The body weight in male rats varied from 20–190 g and in female rats from 20–176 g. Disparity in mean body weights in favour of male rats was also reported in other *Rattus* group (Bently and Taylor 1965; Chandrahas and

Table 2. Body weight and morphological measurements of *R. r. wroughtoni.*

Sex	Sample size	Body weight (g)	Morphological measurements (mm) Head and body	Tail	Hind foot	Pinna
Male	1231	98·93 ± 1·01	140·69 ± 0·68	192·68 ± 0·91	31·45 ± 0·10	19·76 ± 0·08
Female	1408	85·43 ± 0·91	133·04 ± 0·85	183·49 ± 0·92	30·82 ± 0·09	19·36 ± 0·07
CD at $P = 0·05$		2·68	1·86	2·57	0·27	0·21

Table 3. Percentage of pregnancy in different weight groups of female *R. r. wroughtoni.*

Weight group	Sample size	Perforat females Number	%	Pregnant females Number	%
<41	128	—	—	—	—
41–60	262	21	8·02	—	—
61–80	268	227	84·70	13	5·73
81–100	342	342	100·00	51	14·91
101–120	232	232	100·00	64	27·59
121–140	107	107	100·00	30	28·40
>140	69	69	100·00	18	26·87
Total	1408	998	70·88	176	17·67

Krishnaswami 1974). Okia (1976) attributed such disparity in body weights to child bearing which slows down the weight gain in females. Nearly 46% of male rats weighed > 100 g whereas only 29% of the female rats attained this weight (figure 2).

4.3 *Male reproductive condition*

Examination of the testes and epididymal smears in the male rats revealed that they were reproductively active throughout the year. The body weights of those animals with scrotal testes and sperms in the epididymal smears ranged from 58–190 g (mean 114·9 ± 2·75 g); whereas those animals with abdominal testes and without sperms in the epididymal smears weighed from 20–65 g (mean 47·8 ± 0·85 g).

4.4 *Female reproductive condition*

The presence of female rats with perforate vaginae indicated that they were receptive all the year round. The rats with perforate vaginae weighed between 60 and 176 g (mean 100·8 ± 0·74 g) and those with imperforate vaginae weighed between 20 and 66 g (mean 46·5 ± 0·62 g). The percentage of perforate females in different weight classes is given in table 3. Out of the 998 perforate female rats 176 (17·6%) were found to be pregnant. Pregnancy was observed throughout the year (figure 3) with two peaks one during February–March (early summer) and the other during July–August (monsoon). The rate of pregnancy was lowest during summer months (April to early part of June). Similarly uninterrupted breeding was noticed in *R. r. wroughtoni*

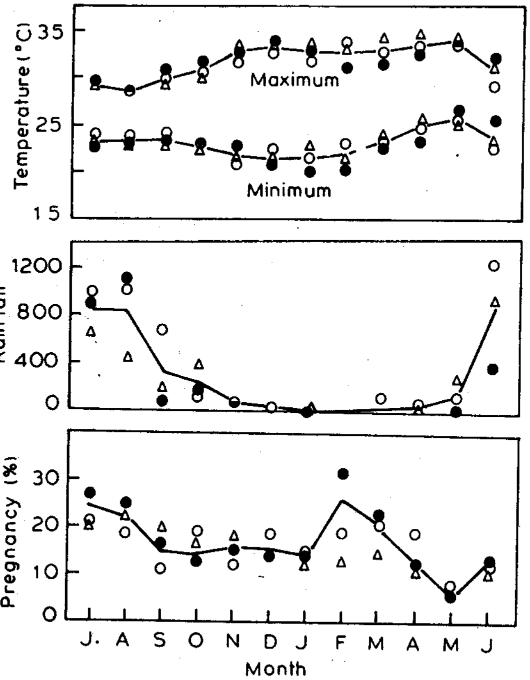

Figure 3. Percentage of total perforate female *R. r. wroughtoni* pregnant in each month. See figure 1 for caption. Data correlated with the weather conditions.

in Hyderabad (Jain 1979) and in *R. r. rufescens* in Pune (Pradhan 1982). Even in the caged condition the *R. r. wroughtoni* was reported to breed throughout the year (Rajagopalan 1972).

The observed percentage of pregnancy in *R. r. wroughtoni* ranged from 6·6 in May to 26·4 in February. In rodents it is not possible to visually detect early stages of pregnancy as the embryos become visible only after the sixth day of pregnancy as bulges in the uterine horns (Keller and Krebs 1970; Tamarin 1977). The gestation period in *R. r. wroughtoni* was 25 days (Rajagopalan 1972). Hence the percentage of pregnancy calculated by the visual observations on the presence of embryos will be about 24% less than the actual value.

In May, the day temperature was maximum (33·5°C). Consequently, the availability of food and water was also less in this month as compared to that in other months. This could be the main reason for the decline in breeding intensity. The peak in breeding was in February which also coincided with the lowest day temperature. During monsoon, though the day temperature was low the torrential rains (>2600 mm in 3 months) restricted the activity and food collection in these rats. Consequently, the rate of breeding during monsoon was not as high as in February. Under similar climatic conditions at Vittal (about 65 km NE of Kasaragod) the breeding intensity in the western ghat squirrels was also very low during monsoon (Bhat and Mathew 1984).

When the pregnancies were correlated with the body weights of female rats (table 3) it revealed that nearly 72% of the breeding females weighed >100 g. The pregnancy was witnessed even at 61–80 g weight class, but the frequency was only around 6%.

4.5 *Juvenile emergence*

The juveniles were seen in the population throughout the year (table 4). This could be attributed to the presence of pregnant females in all the months (figure 3). However, the percentage of juvenile recruitment was little more than the mean during February, April to June and October–November. The young ones of *R. r. wroughtoni* required nearly two months to attain a body weight of about 40 g (Rajagopalan 1972; Advani 1984b). Hence the breeding peak during February–March and July–August might have resulted in the emergence of more number of juveniles during April to June and October–November.

4.6 *Ovulation rate and litter size*

Altogether 176 pregnant female rats were observed for embryos and corpora lutea. The corpora lutea count varied from 1–9, whereas the embryo count varied from 1–8 (figure 4). In corpora lutea counts the majority (67%) of the animals had 5 or more ova but because of the loss of some ova before implantation more than 53% of the animals showed less than 5 embryos. The mean number in these observations was $5{\cdot}24 \pm 0{\cdot}16$ ova and $4{\cdot}49 \pm 0{\cdot}10$ embryos, respectively. Similarly in Andhra Pradesh the black rats were known to have a litter size of 1–9 (Jain 1979). Based on the number of young ones at birth Rajagopalan (1972) had reported a litter size of 1–5 in this rat.

Unilateral implantation was noticed in 11 (6·25%) instances. However, there was no preferential distribution of embryos between the horns.

4.7 *Pre-natal mortality*

This includes two aspects, pre- and post-implantation loss. Out of 176 female rats observed 106 (60·2%) showed pre-implantation losses. In 83 animals one ovum, in 17

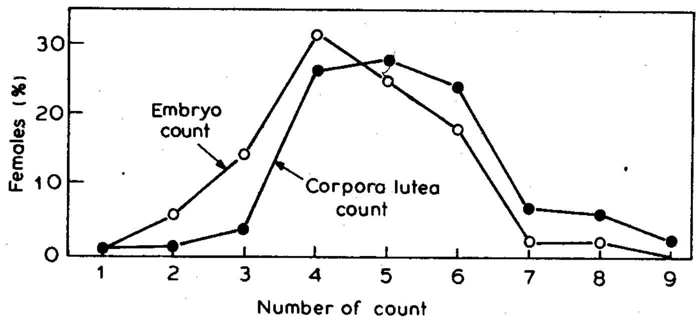

Figure 4. Percentage of females showing various numbers of corpora lutea and embryos in *R. r. wroughtoni*.

Table 4. Monthwise distribution (percentage) of various weight classes in the population of *R. r. wroughtoni* (both sexes pooled together).

Weight group (g)	Months												
	July	August	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	Mean
<41	5·3	4·5	2·7	10·0	9·0	6·4	6·7	8·7	3·4	14·6	7·5	8·6	7·16
41–60	21·7	11·6	7·3	15·6	13·7	16·7	21·4	17·1	12·1	13·9	20·2	21·1	15·91
61–80	16·0	23·9	10·0	13·0	10·7	15·7	14·6	17·9	20·0	16·7	20·8	22·3	16·22
81–100	23·8	27·7	17·4	22·6	19·4	23·0	26·4	25·8	28·3	27·8	23·7	22·3	23·68
101–120	16·0	21·3	20·5	20·0	16·4	19·6	19·7	20·8	21·9	12·5	20·2	15·4	18·76
121–140	12·1	6·5	19·2	10·7	14·6	10·3	4·5	5·4	11·7	9·7	5·2	7·4	10·34
>140	5·0	4·5	22·8	8·2	16·1	8·3	6·7	4·2	2·6	4·9	2·3	2·9	7·92
Sample size	281	155	219	270	335	204	178	240	265	144	173	175	2639

animals two ova in 4 animals 3 ova and in two animals 4 ova were lost. The loss of ovum per female was calculated to be 0·75.

Post-implantation loss was noticed in 5 (2·8%) instances in the sample of pregnant rats. However, the estimate is conservative because: (i) early resorption may be overlooked in examinations of near terminal pregnancies, (ii) embryos destined to resorb in a later stage may be overlooked in examinations of early pregnancies and (iii) resorption of whole litter would be missed entirely. Thus, only pregnant females with visibly resorbing embryos were included in the post-implantation analysis.

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