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Some Population Attributes of the House Rats, *Rattus rattus*, of Rural Central Punjab, Pakistan

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Abstract. Rats were trapped every month for three years from the farm houses and villages of central Punjab (Pakistan). The adult females (88.9 g) averaged heavier than the adult males (83.6 g). The former attained sexual maturity at 73 g and the latter at 76 g body weight. Males were found fertile in every month with no significant seasonal differences. Pregnant females were found during all the four seasons of the year: on the average, 24% of the females were pregnant. Embryonic litter size averaged 6.86 ± 0.21 (SE). Litter size in near-term females was 5.94 ± 0.99 (SE). Adult females outnumbered adult males; the ratio of the two sexes was 1:1.4. Recruitment of the young to the population continued throughout the year. Immature animals constituted 40% of the total number of specimens in the sample.

Key words: House rat, biomass, *Rattus rattus*, population structure.

INTRODUCTION

The ancestral home of the house rat (*Rattus rattus*) is the Southeast Asia, mainland of Indonesia and Philippines. The wild form of *Rattus rattus* is found in the Malayan Archipelago upto the east in the Philippines and Lesser Sunda Island. It is also present in Indonesia and China upto the Yangtze river as well as along the slopes of Himalayas upto north Afghanistan and central Asian countries east of the Caspian Sea (Schwarz and Schwarz, 1965; Schwarz, 1960). From this range the rat spread across India, Pakistan and the Middle East by moving from settlement to settlement along the ancient caravan routes. It was transported by ships from India and Persian ports upto the Gulf of Persia and Red Sea. From here it reached East Africa, Egypt, the eastern Mediterranean, and subsequently to all parts of the world (Brooks, 1973). Besides being the most important pest of food stuffs in Pakistan amongst the mammals of Pakistan (Roberts, 1977) the rat is a carrier of a number of diseases transmissible to humans, such as plague, murine typhus, leptospirosis, trichinosis, salmonellosis, lymphocytic choriomeningitis and rickettsialpox (Davis, 1970; Brooks, 1973).

In Pakistan, the rat is the most widely distributed member of the family Muridae. Here it occurs indoors and is, therefore, confined to cities, towns and villages. The urban segments of this rat's population have been studied in Pakistan in recent years by a number of workers (e.g. Brooks *et al.*, 1994; Ali, 1990; Khan, 1990; Beg *et al.*, 1983; Brooks

and Ahmad, 1986). Our knowledge about the segment of the rat's population inhabiting the rural areas is fragmentary. This paper describes the biomass, reproduction, and population structure of *Rattus rattus rufescens* (Grey) found in the villages and farm houses of central Punjab (Pakistan).

MATERIALS AND METHODS

The present study on the house rat was carried out from July, 1987 through June, 1990. During this period, 12 randomly selected villages, all located within a radius of 70 km of Faisalabad city, were sampled for the rat. Each year all the 12 villages, at the rate of one village per month, were sampled. The same 12 villages were sampled during the same months for three consecutive years. In addition to the villages, 26 farm houses located in the fields at varying distances from the villages were also sampled. The trapping was carried out by using metallic snap traps (17x9.5 cm). Each trapping period lasted for five successive nights. The captured animals were weighed to 0.1 g. The standard body measurements of each captured specimens were taken before being autopsied for the requisite reproductive information.

The points, on body weight (BW) and head and body length (HBL) spectra, at which 50% of the animals showed sexual maturity criteria (such as visible tubules in cauda epididymis or perforate vagina) were determined by plotting the proportion showing the character in each BW and HBL class on arithmetic-probability paper and fitting a line to the data points by eye following Davis (1964). Animals attaining or exceeding these values in BW or in HBL

were considered as adults; all others were classified as immature. In this paper the three year's data has been lumped.

RESULTS

Body size

Table I compares the body weight (BW) of the male and female rats in different head and body length (HBL) categories. In the lower HBL classes, that is, those falling within ≤ 70 -159 mm range, the females generally outweighed the males but not at a statistically significant level; the only exception being the 150-159 mm class in which the females were significantly heavier than the males. In the sample of females having HBL 160 mm or larger the males outweighed the females at statistically significant levels.

Table I.- Head and body length (HBL), and body weight (BW) of the house rats (*Rattus rattus rufescens*) captured from village and farm houses of central Punjab. (BW of pregnant females was adjusted for the weight for the reproductive tract).

HBL classes (mm)	Male		Female	
	n	BW (g)	n	BW (g)
≤ 79	6	10.6 \pm 0.12*	4	11.2 \pm 0.33
80-89	10	15.0 \pm 1.23	5	16.0 \pm 0.62
90-99	22	22.2 \pm 0.90	19	22.1 \pm 1.15
100-109	30	28.1 \pm 1.44	33	30.2 \pm 1.15
110-119	44	36.9 \pm 1.69	48	40.5 \pm 1.20
120-129	35	47.1 \pm 1.21	47	51.3 \pm 1.72
130-139	50	59.5 \pm 1.42	47	63.9 \pm 2.26
140-149	51	71.5 \pm 1.86	84	73.6 \pm 1.50
150-159	64	85.1 \pm 1.62	95	92.1 \pm 1.77**
160-169	92	105.3 \pm 2.02	85	105.1 \pm 1.75
170-179	67	128.4 \pm 2.66	131	124.2 \pm 1.59
180-189	39	146.6 \pm 4.11	60	135.1 \pm 2.91*
190-199	31	165.4 \pm 3.83	24	151.0 \pm 4.60*
≥ 200	9	199.6 \pm 4.65	6	187.2 \pm 4.95*
Total	550		688	
BW (g)		86.9 \pm 2.02		89.9 \pm 1.54
HBL (mm)		148.7 \pm 1.26		151.5 \pm 1.04

*Mean \pm SEM *P<0.05; **PP<0.01.

Reproduction

Fifty percent or more of the males attained sexual maturity at 150mm HBL and 76 g BW, and the females at 145mm HBL and 73 g BW. Breeding males were recorded in all the seasonal samples and no significant seasonal variation was observed in the proportion of such males. In the sample of adult females, maximum prevalence of pregnancy was recorded in the summer samples (34%) and the minimum in the spring samples (18%); the average for all the four seasons was 24%. Prevalence of

Table II.- Body weight (g) and head and body length (mm) related variations in the prevalence of pregnancy and mean litter size in adult female *Rattus rattus rufescens* in rural central Punjab.

Classes	Percent pregnant		Litter size	
	No.	Percent	No.	Percent
BW (g)				
60-79	25	0.0	-	-
80-99	129	10.9	14	5.07 \pm 0.45
100-119	102	25.5	26	6.31 \pm 0.37
120-139	91	35.2	31	7.29 \pm 0.33
140-159	66	36.4	24	7.92 \pm 0.43
160-179	22	31.8	6	6.67 \pm 1.28
180 >	7	57.1	4	5.75 \pm 1.03
Total	442	23.8	115	6.86 \pm 0.21
HBL (mm)				
140-149	48	10.8	5	4.00 \pm 0.57
150-159	95	18.9	18	6.11 \pm 0.45
160-169	87	22.4	19	6.79 \pm 0.46
170-179	131	27.5	35	7.40 \pm 0.28
180-189	60	33.3	20	7.20 \pm 0.37
190-199	22	18.2	5	9.20 \pm 1.27
200 \leq	8	37.5	3	7.00 \pm 1.73
Total	449	23.4	115	6.86 \pm 0.21

pregnancy varied in relation to BW ($X^2=58.041$; d.f.=6; $p<.01$) as well as HBL ($X^2=18.364$; d.f.=6; $p<.01$); the larger females being more reproductive. There was no seasonal variation in the size of the embryonic litters. However, BW ($F=4.767$;

Table III.- A comparison of the population attributes of *R. rattus* populations from several urban and rural localities in South Asia.

Locality	Mean body weight (g)		Weight (g) at sexual maturity		Reproduction		Sex ratio*	% immature	References
	Male	Female	Male	Female	% pregnant	Embryo/ female			
India									
Belgaum	-	-	-	-	43	5.3	-	-	Lloyd (1909)
Jodhpur	76	77	> 80	> 70 (Corpora lutea)	26	6.6	121	54	Advani and Rana (1984)
Pakistan									
Faisalabad city	94	88	-	-	36	6.2	117	33	Mushtaq-ul-Hassan (1981)
Faisalabad city	94	89	88	82 (Perforate vagina)	24	6.7	120	45	Ali (1990), Khan (1990)
Rawalpindi city	147	138	> 96	80 (Corpora lutea)	35	6.6	100	13	Brooks <i>et al.</i> (1994)
Rural Central Punjab	84	89	76	73 (Perforate vagina)	24	6.9	125	40	Present study

*Number of females per 100 males.

d.f.=5.99; $p < .01$) and HBL ($F=3.889$; d.f.=6,98; $p < .01$) related variation in the mean litter size was significant. The largest litter size was recorded for the females' of BW class 120-139 g and HBL class 190-199 mm (Table II). An average female produced a litter of $6.86 \pm .21$ ($n=115$) embryos. But this estimate is based on counting of embryos in different phases of development. On account of the possibility of pre-natal mortality, the litter size at birth should expectedly be smaller. Accordingly in near-term females, the embryonic litter averaged 5.94 ± 0.99 ($n=32$) which should be a better proximation of the litter size at birth.

Population structure

The ratio of the two sexes of the adult rats was significantly skewed in favour of the females (1:1.4; $n=744$; $X^2=22.268$; d.f.=1; $p < .01$), but in the case of immature rats the ratio did not deviate significantly from 1:1 ($n=494$). Immature rats were recorded throughout the year. The highest proportion of immature rats was recorded in the summer (46%) and the lowest (35%) in the winter samples, while in the fall and spring samples the proportion was 43% and 37%. The average for all the seasons was 40%.

DISCUSSION

The profile of the *R. r. rufescense* population affecting the rural habitations of central Punjab is as follows: The adult females average heavier (88.9 g) than the adult males (83.6 g). The former attain sexual maturity at about 73 g whereas the latter at about 76 g. In the annual samples, the proportion of pregnant females averaged 24%. The average litter size is 6.9 but in near-term pregnant females the litter size average 5.9. Adult females outnumbered adult males; there being 125 females for every 100 males. Recruitment of young rats to the population takes place throughout the year. About 40% of the rats in the annual sample are immature.

The house rats from Jodhpur (India) weighed lighter than those from the more northerly populations of Pakistan (Table III). The specimens from rural central Punjab (Pakistan) averaged lighter than the ones from the urban areas. Specimens from the northern most population at Rawalpindi city weighed a lot more heavier than those from Faisalabad city. Thus difference in the body mass of the rat populations seems to be related partly to the habitat type and partly to the latitude.

Body weight of sexual maturity in the rat samples from Pakistan was roughly related to their respective average biomass. Thus the rats having larger biomass attained sexual maturity at heavier body weight. But the Jodhpur rats were different in this respect. In spite of their smaller biomass, they attained sexual maturity at body weight comparable to the rats from rural Punjab.

Excepting the Rawalpindi rat population, female rats outnumbered the males in several of the local populations (Table III). Harrison (1952) and Brooks *et al.* (1978) too noted predominance of females in their samples of *R. rattus* from Malaysia and Burma. The data of Table III suggest that the local rat populations having higher prevalence of pregnancy generally tend to have smaller litters, and that the same local population may have larger litters and smaller prevalence of pregnancy in one year and just the opposite in another year (see Ali, 1990; Khan, 1990; Mushtaq-ul-Hassan, 1981). Prevalence of pregnancy and embryonic litter size in three local rat populations viz., those from rural Punjab and from Faisalabad (Ali, 1990; Khan, 1990) and Jodhpur cities were comparable. Rawalpindi and Faisalabad (Mushtaq-ul-Hassan, 1981) rat populations were closer to each other especially with respect to their rates of pregnancies. But when the rates of recruitment of young were compared, the Rawalpindi and Jodhpur rat populations stood at the two different ends with populations from Faisalabad city and rural Punjab occupying intermediate positions. The former two populations also differed from each other with respect to their body weights, weight at sexual maturity and sex ratio. The rat population from rural Punjab was closer to the population from Jodhpur with regard to body weight of sexual maturity, rate of pregnancy, litter size, sex ratio, and to some extent with respect to the rate of recruitment of the young to the populations. Thus, as pointed out by Brooks *et al.* (1994), the different local populations of the rat have developed different

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