

Studies of some aspects of rodent ecology in the four districts of the gangetic plain of West Bengal, India

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Abstract: This study has been conducted in four Districts (i.e., Nadia, North 24-Parganas, Hooghly and Burdwan) of the Gangetic plain of West Bengal, India. The results of the present study indicate that these Districts are badly infested by various types of rodents. Among them wild Indian house rat (*Rattus rattus*) is quite preponderant followed by field mice (*Mus musculus*), Norway rat (*Rattus norvegicus*) and Indian mole rat (*Bandicota sp.*). Percentage of the female individual of these species is higher than the male individual. They cause severe types of damages in the fields and houses. In the District Nadia, Hooghly, North 24-Parganas and Burdwan, paddy and potato were damaged and estimated during the study period. Other crops and vegetables such as wheat, gourd, cauliflower, cabbage and jute were also damaged by the rodents. Household properties e.g., books, clothes, utensils and electronic goods were also destroyed by the rats. Damages were maximum in the mud built houses. They build their nest and burrows in the upland, trees and periphery of the field but extensive damages were noticed in the centre of the field. Rodents breed throughout the year but peak breeding seasons are August to October and late winter season and average litter size is about 6 to 8. The present study also points out the migratory behavior, hoarding materials in the burrows, nature of damages in relation to field conditions. For the control operation of the rodents and especially the rats, it is essential to have a clear-cut idea about the species present in the area, their habit and habitat, mode of burrowing, their movements, preference of food and a detailed life history of predominant rodent species. These aspects have been thoroughly studied in the present investigation.

Key words: Gangetic plain, West Bengal, rodents, *Rattus rattus*, paddy, burrow.

Introduction

Among vertebrate pests, rodents are the most destructive to the agricultural produce in India. These rodents cause damage to the standing crops due to their burrowing, cutting and hoarding activities, to food in storage, in poultry farms and to other commodities. In addition to these damages, they are also responsible for transmitting various types of diseases (WHO, 1974).

Different workers have reported estimates of crop losses incurred by rodents alone from time to time. In a recent report, the extent of crop loss by the rodent has been estimated to the tune of 165 crores of rupees annually in sugarcane, wheat and paddy in the state of Punjab alone (Anonymous, 1987). According to Prakash *et al.* (1986), the damage to the paddy tillers was significantly ($P < 0.01$) more in the centre of the paddy fields than at the periphery and middle zone. About twelve vegetable crops like tomato, brinjal, carrot, sweet potato, raddish, cabbage, cauliflower, onion, garlic, spinach, bottle gourd and okra, have been reported to be susceptible to rodent attack (Advani & Mathur, 1982). Earlier Hoff *et al.* (1976) estimated the extent of rodent damage to vegetables to be 5 to 10% in Bangladesh, upto 10% in Gujrat and 5 to 10% in Tamil Nadu. However, Chopra & Parshad (1986) estimated this loss to the tune of 13.86% per pick in the State of Punjab. Besides the field crops, vegetables and fruit crops, rodents also adversely affect the trees generally in two ways, debarking off and completely slicing the stem (Prakash & Mathur, 1987).

In comparison to Indian scenario, the situations in the Gangetic plane of West Bengal are quite a bit different. The soil conditions in these regions are also varied. Due to the diversity in the soil condition there are some differences in the agricultural productions also. But there is no substantial report regarding the various information about the rodents, nature of damages and controlling measures. Considering all the ideas, an attempt has been made to investigate the actual rodent species, their nature of damages, and location of the breeding places throughout the year in the four District of the Gangetic plane of West Bengal. As there is no specific scientific approach for controlling operation of the rodents in West Bengal, so this study will also help to unveil the situation and will help to strengthen the internal economy of our country.

Materials and Methods

Study area and duration: This study has been conducted in four Districts (Nadia, North 24-Parganas, Hooghly and Burdwan) of West Bengal in the year 1998 to 2000. They are situated in the Gangetic plain. Within the Districts, fields, housing complexes, grocery shops and market complexes were selected for the collection of data.

Questionnaire and data collection: Nature of damages was assessed using various types of questionnaire on the local population (1000 people/district). In the field, burrows were counted and dug out. The amount of

hoarded food materials by the rodents within burrows were collected and measured. In agricultural or barren lands, live burrows were identified and counted according to Chopra et al. (1996).

Trapping of rodents: Specially made wire cages (12"x6"x4") were used for capturing the rodents both from the fields and housing complexes. After capturing, the rats were taken to the laboratory and identified properly.

Statistical analysis: All the data were calculated by i) Large sample test for equality of two proportion and Frequency chi- square test for large sample test (Rao, 1952 and 1974) ii) Student 't' test (Fisher, 1963).

Results and Discussion

All these four Districts are agriculture dependent. Paddy, wheat, potato, parwal, gourd, vegetables, jute, cabbage, cauliflower and bringel are the main agricultural products. Our survey report revealed that maximum people cultivate purwal, Dal, Cabbage and jute in Nadia; potato, paddy and wheat in Hooghly; vegetables and paddy in North 24- Parganas; gourd in Burdwan District .

Brick built, mud built, thatched housing complexes were found in all the survey areas of the four Districts. Among them mud built houses in the District, Nadia, Hooghly and Burdwan and brick built houses in the District North 24-Parganas were maximum . The present study clearly indicates that all the four Districts are rat infested. *Rattus rattus*, *Rattus norvegicus*, *Mus sp.* and *Bandicota sp.* are found in these areas. Among them presence of the *R. norvegicus* in the District North

24-Parganas, *R. rattus*, *Mus sp.* and *Bandicota sp.* in the District Burdwan were reported to be maximum in percentage. It has been noticed that among the rodents present in two Districts (i.e., Nadia and North 24-Parganas), percentage of *R. rattus* is quite preponderant (70.79%). It is followed by *M. musculus* (20.79%), *R. norvegicus* (7.9%) and *B. indica* (0.51%) respectively. It is also evident that the proportion of female individuals is quite higher than the male.

Rodents cause damages young plants, fruits, seeds, panicles of the paddy and wheat both in the field and houses. Damages of plants by the rodent pest were reported to be maximum in percentage reported by the people of the District Nadia. Maximum people of the District North 24- Parganas reported about the fruits and seeds damage and people of the Burdwan District reported about the damages of panicle of paddy in the field (Table 1). Out of the four types of rodents, maximum people of the Districts Nadia, Hooghly and North 24-Parganas reported that *R. rattus* is the major destructive pest and people of the District Burdwan reported that the *Mus sp.* is the most destructive rodent pest cause huge amount of damages both in the fields and housing complexes where storages of paddy were usually made. It was observed that number of burrows in the periphery during maturation, harvesting and post harvesting phase of paddy were higher than the centre. But the results are not statistically significant among the four Districts during the year 1999 to 2000. The storage of paddy in individual burrow in these four Districts was not statistically significant (Table 2).

Table 1. Percentage of major rodent species, damage type and the key rodent species causing damages in the four Districts of West Bengal

Districts	Views of the villagers about the percentage of major rodent species				Types of damages (reported by the percentage of the People)				Types of rodents causing major damages (reported by the percentage of the People)			
	<i>Rattus rattus</i>	<i>Rattus norvegicus</i>	<i>Mus sp.</i>	<i>Bandicota sp.</i>	Plant	Fruit	Seeds	Panicle	<i>Rattus rattus</i>	<i>Rattus norvegicus</i>	<i>Mus sp.</i>	<i>Bandicota sp.</i>
Nadia	94.60 ± 2.43*	54.94 ± 10.29	94.30 ± 2.94	14.94 ± 5.85	53.83 ± 9.50	34.98 ± 5.98	12.95 ± 4.84	54.77 ± 6.78	77.91 ± 4.79	19.90 ± 6.31	35.87 ± 8.49	1.31 ± 1.31
Hooghly	99.00 ± 1.00	62.32 ± 32.13	78.64 ± 19.19	15.28 ± 11.91	49.33 ± 13.18	48.06 ± 7.16	26.02 ± 0.45	31.91 ± 4.94	44.53 ± 13.02	35.30 ± 9.16	39.67 ± 17.51	0.00
North 24-Parganas	81.43 ± 14.60	76.17 ± 19.81	63.89 ± 32.03	79.45 ± 16.56	46.78 ± 13.45	52.49 ± 18.50	28.77 ± 2.28	49.42 ± 10.13	93.25 ± 0.89	39.33 ± 27.25	23.98 ± 21.40	0.00
Burdwan	100.00 ± 0.00	48.97 ± 15.69	100.00 ± 0.00	81.71 ± 2.98	28.97 ± 5.06	48.48 ± 2.24	0.00	83.28 ± 2.21	50.65 ± 9.06	0.00	88.86 ± 1.48	0.00
X²	0.095 NS	0.304 NS	0.430 NS	6.220 NS	0.380 NS	0.310 NS	0.790 NS	1.110 NS	1.100 NS	0.830 NS	2.410 NS	0.090 NS

*Mean ± Standard error, NS: Not significant

Table 2. Number of burrows in various stages of crop cycle and storage of paddy in the paddy fields in four Districts (Nadia, North 24-Parganas, Hooghly and Burdwan) of West Bengal during the year 1999-2000.

Districts	Sowing and germination of seeds (burrows /field)		Tillering (burrows /field)		Ripening of panicles, i.e., maturation (burrows /field)		Harvesting (burrows /field)		Post harvesting (burrows /field)		Total number of live burrows count at one crop cycle /village	Total number of dead burrows count at one crop cycle /village	Storage of paddy (gm.) /burrows during maturation stage
	Centre	Periphery	Centre	Periphery	Centre	Periphery	Centre	Periphery	Centre	Periphery			
Nadia (7)*	0.013 ± 0.013**	0.41 ± 0.10	0 ± 0.35	0.72 ± 0.35	0.82 ± 0.26	3.25 ± 0.37	1.31 ± 0.23	3.69 ± 0.31	0.85 ± 0.23	4.17 ± 0.41	267.0 ± 28.75	50.14 ± 16.7	42.69 ± 8.97
North 24 parganas (5)	0.56 ± 0.24	0.41 ± 0.16	0 ± 0.48	0.73 ± 0.48	1.03 ± 0.52	3.55 ± 0.45	1.03 ± 0.22	4.39 ± 0.59	1.42 ± 0.42	4.12 ± 0.85	219.0 ± 43.91	77.2 ± 20.11	50.39 ± 25.42
Burdwan (5)	0.21 ± 0.20	0.45 ± 0.14	0 ± 0.58	0.95 ± 0.58	0.72 ± 0.22	4.10 ± 0.31		3.84 ± 0.56	1.11 ± 0.30	3.90 ± 0.75			29.49 ± 18.22
Hooghly (5)	0.56 ± 0.06		0 ± 0.35	0.81 ± 0.35	1.24 ± 0.34	3.12 ± 0.41	0.66 ± 0.07	2.19 ± 0.52	1.04 ± 0.27	1.59 ± 0.27	128.8 ± 17.68	65.8 ± 10.58	0.00
X ²	0.244 NS	0.027 NS	0 NS	0.002 NS	0.009 NS	0.009 NS	0.013 NS	0.038 NS	0.009 NS	0.070 NS	2.670 NS	0.348 NS	0.833 NS

*Number of villages, **Mean ± Standard error, NS: Not significant

During summer season and in the high yielding varieties of paddy field, the number of burrows and storage of paddy within the burrows were statistically significant. These results were considered during the two-year period i.e., 2000 and 2001. Burrows in the wheat fields in the Districts Nadia during the years 1999 and 2000 were counted. These results indicated that the number of burrows in the centre of the mature wheat field were higher than the periphery. Height of stubble of wheat plant from the ground to (13.58 ± 4.02 cm to 15.49 ± 0.66 cm) cut portion and length of the panicle stored (5.50 ± 0.17 cm to 7.55 ± 1.09 cm) by the rodents were also measured in the wheat fields of the district Nadia .

In the District Nadia, damages were also observed in the cauliflower fields for the two (2000 and 2001) years. The results revealed that the damages were less than one percent and statistically not significant when compared between two years.

Villagers of these four Districts used gola, jute bag and floor of the houses for keeping their agricultural products. Present study revealed that jute bag in the Districts Nadia, Hooghly and North 24-Parganas, gola in the District Burdwan are commonly used item for this purpose. But maximum damages were noticed in the jute bag. Other than crops, clothes and beddings, straws, books, papers, plants and jute bags are also damaged by the rodent pest. Amongst these items, the damages of clothes and bedding seems to be maximum .Rodents ate and contaminated various types of agricultural products and made them unsuitable for human consumption. In the District Nadia paddy (8.62% to 9.5%) and potato (6.33% to 6.5%); in the District Hooghly paddy (8.43% to 9%) and potato (6% to 6.25%); in the District North 24-Parganas paddy (5.75% to 6.23%) and potato (4.5% to 5.3%) and in the District Burdwan paddy (5.75% to 6.5%) and potato (4.33% to 7.8%) were damaged. In addition to these items, wheat, jute and vegetables, gourd, tomato, cauliflower and cabbage were also damaged by the rodents (Fig. 1).

About the migratory behavior of the rodents, people of the four Districts reported that the rodents come to the house from outside or remain inside the house. They usually come to the house from outside (reported by the maximum number of villagers of the Districts Nadia, Hooghly and North 24-Parganas) but they remain inside the houses (reported by the maximum number of villagers of the District Burdwan).

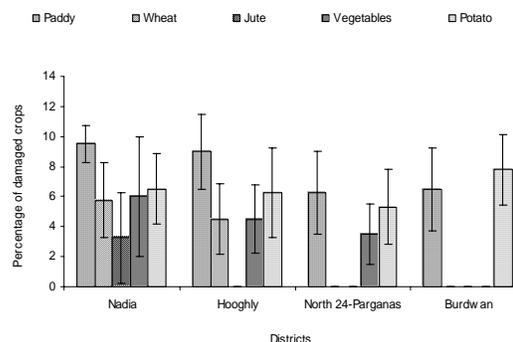


Fig. 1. Percentage of major crops damaged by the rodents in four Districts of West Bengal

Rodents are the prolific breeders and breed throughout the year. The peak breeding period ranges from May to October. It is also reported that less reproductive activity is found during the months of December to April of the year (Fig. 2).

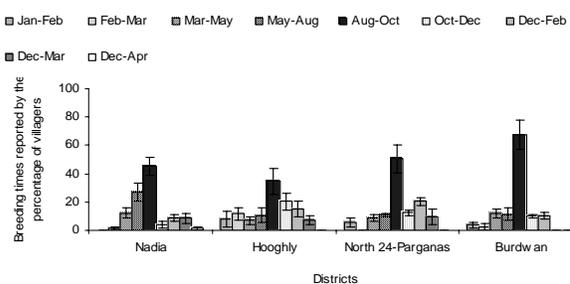


Fig. 2. Breeding time of the rodents in four Districts of west Bengal

The breeding places of the rodents in these Districts may vary. They may use various items and places i.e., bedding, shelf made of bamboo sticks, burrows, papers, jute bags, trees and hay for breeding purposes. Amongst them burrows in Nadia and Hooghly, bedding in North 24-Parganas and hay in Burdwan District were reported to be maximum. About their litter size, it has been reported that in the Districts Hooghly and Nadia, it may vary from 6 to 8, in North 24-Parganas 4 to 6 and in Burdwan 10 to 12 (Fig. 3A and 3B).

The *R. rattus* mostly inhabits in the buildings, crop field, garden, grain houses and trees. They usually prefer both kharif and rabi crops. Their burrows are almost found in the floor or wall in semidry or dry soil. They hoard panicles of paddy, wheat and tomato into the burrows. The burrows of the *R. norvegicus* species are found near the water source of dry and wet soils and fields. They hoard paddy, wheat, crabshell, snail etc into the burrows. *M. musculus* are mainly inhabits in houses, kitchen, and storerooms but they are also found in the paddy fields. Their burrows are always found in the mud floor and mud walls. They always built their burrows in dry soil. Amount of soil are small with very fine granules. *B. indica* usually lives in buildings, water source paddy and potato fields. Burrows are found in the floor and in wet soil. Huge amount of soil with large size granules are found outside the burrows. They hoards snail, fish and fewer amounts of paddy and wheat.

Most of the people of these four Districts lead their live below poverty level. There is no enough space for keeping the agricultural products within the protected containers. Naturally they have to keep the products in the open space and courtyard of their houses. Most of the houses are mud built. It has also been observed that these villages are completely surrounded by the fields. So damages of these villages are quite higher. In the suburb areas where brick built houses are quite common, the nature of the damages in these houses are quite a bit different than the remote village areas. In the suburb town, the damages in the shops and office complexes have also been noticed. The damages are mainly found during the time of rainy season in the houses and during post monsoon and winter in fields.

It has been noticed that among the rodents present in these regions, percentage of *R. rattus* is quite dominant than other species. It is followed by *M. musculus*, *R. norvegicus* and *Bandicota indica* respectively. It is also evident that the proportion of female individuals is quite higher than the male. The exact reason is not known. Four species of rodents have so far been reported by the people of these four Districts. An extensive studies indicate that the crop

pattern of these four Districts were more or less similar. Regarding the extent of damages it is noticed that in comparison to other vegetables (e.g., tomato, gourd, cabbage, cauliflower, brinjal etc.), the damages in the paddy, wheat and potato field are quite enormous in these areas. It is also noticed that the damages of crops in the centre of the paddy and wheat field are quite extensive which was also mentioned earlier by Prakash & Prakash (1985).

From the investigation it is known that they ate and contaminated the food materials in the residential premises, destroyed household properties e.g., books, clothes, utensils and even the sophisticated electronic goods. The estimation of losses due to rodents in the crop fields differs from place to place, irrigated and nonirrigated areas of these Districts. Density of the rodent population and availability of the crops may be the reason for these losses. *R. rattus* is the most predominant species reported to be found both in the mud built and brick built houses. *R. rattus* and *M. musculus* are known to eat and contaminate the food material in the residential premises and thus making them unfit for human consumption (Pingale *et al.*, 1967).

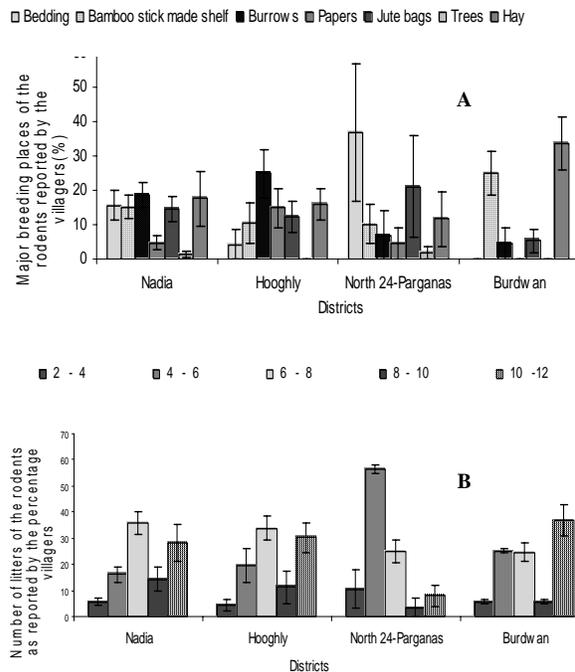


Fig. 3. (A; B) Major breeding places and number of litters available in rodents in four Districts of West Bengal

Damages of the crops were noticed in various fields of these four Districts, in different stages of crop cycle. In the paddy and wheat fields the burrows were specifically noticed. It has been observed that number of burrows in the periphery during the maturation, harvesting and post harvesting phase of paddy were

higher than the centre. But the results are not statistically significant. *R. rattus* and *R. norvegicus* are the major important species in the field. Burrows in the wheat fields in the District Nadia during the years 2000 and 2001 were counted. Number of burrows in the centre of the mature wheat field were higher than the periphery. Number in the centre of the year 2001 was significantly greater than the year 2000. Height of stubble of wheat plant from the ground to cut portion (13.58 ± 4.02 cm to 15.49 ± 0.66 cm) and length of the panicle stored (5.50 ± 0.17 to 7.55 ± 1.09 cm) by the rodent were measured. According to Chopra and Gupta (1987), Indian mole rat (*B. bengalensis*), the soft-furred field rat (*R. meltda*) and the field mice, *Mus sp.* Cut the paddy tillers about 10-15 cm above the ground, eat the medullary part of the stems after breaking them into bits, the latter are scattered randomly in the fields (Prakash *et al.*, 1986; Kapoor and Kushwaha, 1988). Damages during the tillering and maturity stages of the crop by the rodents were reported by Chopra and Sabharwal, 1992; Sridhara, 1992.

Rodents are the prolific breeders and breeds throughout the year. The peak breeding period of the rodents, types of breeding places and their litter size have been described in the present investigations. The majority of the adult females are pregnant during June, July and August and litters ranging in size from 1 to 12; mean size is between 4.8 and 5.32 (Asdell, 1964). The model litter size has been recorded as 5 (Harris, 1979). The house mouse, *M musculus* reproduces throughout the year in favourable conditions of food supply and temperature. The mean litter size varies from 3.9 to 6.4 and annual productivity from 29.1 to 57.2 young per female (Southwick, 1966). *B. bengalensis* breeds throughout the year. It was reported that in Calcutta, the prevalence of pregnancy varies from 13 to 67 percent (Spillet, 1968). *R. rattus* breeds throughout the year as evident from the monthly data of the trapped female that were mated in nature itself. But two peaks were observed in the breeding frequency, one during monsoon (July to September) and the other during late winter or spring (March to April). The rate of pregnancy is lowest during summer (April to June) and post monsoon (October to December). Fluctuation in the population was also noticed and can be correlated with breeding frequency of *Rattus* species. It is assumed that availability of food materials played a key role for this type of fluctuation. Observations also indicate that the males were fecund throughout the two years and no seasonality in male reproduction could be observed in the population. Yashoda *et al.* (1977) also studied the reproduction in naturally occurring populations of *R. rattus*. They observed (in the western part of India) two peaks of reproduction in this species

i.e., March to April and August to September and the litter size ranged from 1 to 9, the average being 5 to 8 young ones.

The environmental factors like temperature, photoperiod, rainfall and food play a very important role in the reproduction of rodents. Actually it is the complex interaction of all these variables that determines the reproductive activity of a species (Chopra *et al.*, 1996). Temperature of the environmental factors thought to play a part in suppressing reproduction during winter is low environmental temperature (Pearson, 1963; Delong, 1967). During winter, there is a reduction in the number and size of litters produced (Ohzu & Sato, 1963). Breeding in certain species of herbivorous and carnivorous rodents is related to during or following periods of heavy rains. The food supply of these rodents is dependent on rainfall; the prolongation of the normal rainy season may generate excess food and cover, resulting in an extending breeding and unusually large number of these rodents. In *R. rattus* (Davis, 1953) and *R. fuscipes* (Wood, 1971 b) breeding mainly occurred in warm wet summer months and it virtually ceased in cool drier months. Relationships between fecundity and both quantity and quality of food have been shown (Eskes, 1983; Alibhai, 1985). Cessation of breeding activity can be related to progressive decrease in the amounts of available food. Onset of rainfall could possibly be an indirect factor in regulating the population by causing vegetative growth and thus an increase in food supply. It is difficult to correlate the lowering of breeding rate in summer months with food scarcity as this species usually has enough food throughout the year. So ambient temperature is the factor to be considered here. According to Rao & Balasubramanyam (1992).

The preponderance of females in these four Districts was observed almost throughout the year. On an average the females outnumbered the males. That females can withstand the vagaries of climatic conditions and fluctuations in food availability more than males may be the causative factor for the preponderance of female number in natural population (Rana, 1992). Also intermale aggression in the home range has been observed in bandicoot rats (Chakraborty & Chakraborty, 1982) and adult house mice (Mc Kinney *et al.*, 1975). These reports point out that the damage in the rural areas are very severe than the urban or semi urban areas. This observation points out certain caution that rodents should be judiciously controlled through some integrated approach.

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