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## **Analysis of rodent diversity and their risk assessment trends in rural and urban dwellings in district Karnal and Panipat of Haryana.**

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### **ABSTRACT**

Rodents (rats and mice) are always witnessed as greatly diversified mammals in terms of their habits and modes of life in natural as well as manmade situations. Their ingressions in the dwellings, either used for domestication or commercial purposes, pose health risks as well as huge economic nuisance. They are mainly observed as pest because of their modes of feeding habits (gnawing, scrapping and nibbling) leading to consumption and contamination of food and drinks. They not only lead to deterioration of various commodities in domestic and commercial establishments, but also threaten public health and quality of life, since they contribute to the spread of diseases and ectoparasites. Heat waves might drive rodents indoors in search of water and thus increase contact with human beings and hazard of exposure through the inhalation of virus aerosol from the excreta of infected rodents. Rodent contaminates food and water by faeces and urine and thus transmit many viral and bacterial diseases to humans. A widespread record of various structural damages to building furnishings (wooden furniture, carpets, papers, plastic utensils etc.) and electronic gadgets (personal computer, scanners, printers etc.) and home appliances like refrigerator, washing machine and vacuum cleaners is observed as the part and parcel of their risk assessment trends. Therefore, the baseline data on species diversity, relative abundance and risk assessment trends of notorious vertebrate pests may prove inventory step to get rid or manage them in dwellings established in urban and rural situations.

**Key words:** Diversified mammals, ingressions, deterioration, public health, ectoparasites, economic nuisance etc.

## INTRODUCTION

Rats and mice are the most successful and abundant vertebrates, next to human being, on this planet. About 40% mammalian species and genera have been traced as rodents (Anderson and Jones, 1984). Out of these, about 4 families (Sciuridae, Hystricidae, Zapodidae and Muridae), 46 genera and 128 species represent the rodent fauna of Indian sub-continent (Ellerman 1961, Roonwal 1987). In India alone, it includes about 4 families, 43 genera and 99 species (Corbet and Hill 1986). On the basis of their ecological and behavioural studies, in all, 18 species are identified as serious pests of agricultural as well as domestic settings (Roonwal, 1987 and Parshad, 1999). Their ingress in different tropical habitats lead to ravage of crops, fruits, gardens, orchards, and stored food grains. Moreover, they cause structural damages to the properties of various kinds resulting in huge economic losses (Brown et al. 2008). In domestic and commercial establishment, they survive at man's expense, share his food and water resources, and live in his close association, contributing nothing any beneficial to the relationship (J.E. Brooke & W.B. Jackson, 1973). They prefer the habitat providing shelter, and with enough supply of food and water. Shelter is required to protect themselves from predators and harsh weather conditions, and to bear and rear their young ones. Some old-world species of rodents including house rat or roof rat (*Rattus rattus*), brown rat or Norway rat (*Rattus norvegicus*) and the house mouse (*Mus musculus*) are categorized as commensal rodents of human dwellings. These are brought to Asian countries on European trading ships during the 17<sup>th</sup> and 18<sup>th</sup> centuries. They usually rest in buildings established for human habitation as well as commercial activities because of enormous hiding areas and rich supply of food and water available to them in these sites. They interact extensively with their environment (physical, chemical and biotic) with complex effects on other organisms (plants and animals) on spatial and temporal scales (Dickman, 1999).

### Ecological Significance of Rodents:

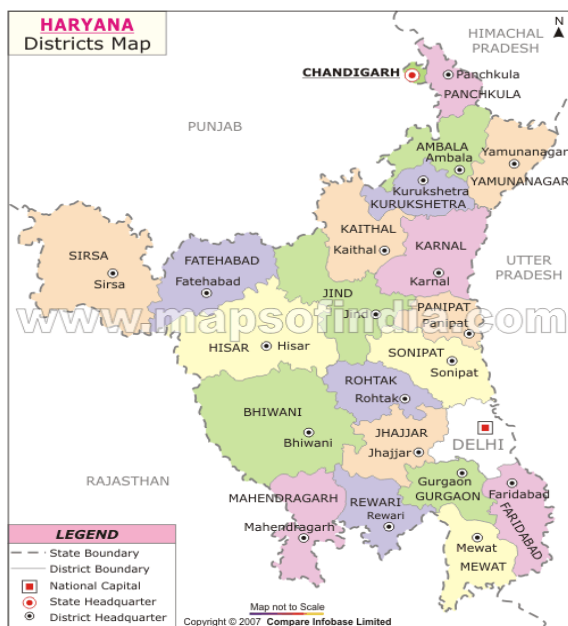
Rodents are not only devastating mammals but also economically important in almost all tropical habitats as seed dispersal agents, consumers of invertebrates, prey for carnivorous snakes, other mammals and birds (Kylie and Richard, 2006). Key roles of rodents include considerably increasing the diversity of ecosystems, being prey species, consumers of vegetation and small animals, and dispersers of seeds and mycorrhiza fungi (Horvath et al. 2001). Rodents are important link in food chain between plants and the carnivorous predators hence it plays an important role in ecosystems. One of the important things is that rodent

species always prefer a specific habitat throughout its life than using the complex environmental measures that define a particular habitat. Hence, certain rodent can be used for monitoring the distribution as well as the density and to indicate the health of biotic system (William and Lidickes,1989). Rodents are important study organisms for determining biodiversity among a variety of habitat types within a landscape because they fulfil multiple ecological roles (Horvath *et al.* 2001).

## MATERIAL AND METHODS

### Study Sites:

To collate the experimental observations, the study is conducted in two adjoining districts namely Karnal and Panipat of northern part of Haryana, located on the western bank of river Yamuna separating Haryana from Uttar Pradesh (Fig-1).The housing facilities in this populated area are characterized by poor sanitation system especially in the rural background with the history of rodent infestation. In all, 10 study sites (5 from urban and 5 from rural) are randomly selected in this area. In each study site, 10 residential premises are selected to ascertain species composition, relative abundance, and risks of rodent infestation. With the help of multi-catch wonder traps, periodic trapping of rodents is done for two consecutive days at each experimental site. Cracked wheat grains smeared with about 2% vegetable oil is used for pre-baiting. The captured rodents are identified following Jain *et al.*(1992) and their per cent relative abundance is calculated.



Karnal  
Distt.  
Panipat  
Distt.



Fig. 1 Map of Haryana showing location of study sites (Karnal and Panipat).

### **Rodent Infestation Measurement:**

Level of infestation can be ascertained as follows-

Trap index ( $I$ ) =  $\frac{m}{x.t}$  (rodents/trap/day or rodents/100traps/day)

$m$  =total number of rodents trapped

$x$  =total number of traps set

$t$  =Number of days during which traps were set.

Track marks census using white paper markers (20x20 cm) having marking ink coated polythene sheet (8x8 cm) is recorded and per cent rodent activity ( $a/a+b /100$  where  $a$  = number of markers showing rodent activity, and  $b$  = number of markers without signs of rodent activity) is calculated.

Similarly, the bait census (g/bait box/day) by using specially designed protected bait containers (32cm x 22cm x 32cm) made from locally available empty tin boxes is calculated.

### **Rodent Pests Infestation Risks Assessment:**

Major risks and level of rodent infestation in dwelling areas can be ascertained by recording positivity of structural damage to various household articles and the percentcontaminated samples out of collected samples of foods, stored grains, grocery items, fruits, vegetables etc.

### **OBSERVATIONS AND RESULTS**

The captured rodent communities in the study area are consisted of house rat (*Rattus rattus*), the house mouse (*Mus musculus*), lesser bandicoot rat (*Bandicota bengalensis*) and insectivore mammal (*Suncus murinus*). Out of these *R. rattus* is reckoned to be the most predominant rodent pest. The lesser bandicoot rat (*B. bengalensis*) is mostly captured in the premises used for green groceries (fruits and vegetables marketing sites). One insectivore species *Suncus murinus* is also trapped in the extent of vestige. An arboreal and opportunistic mammal, the five-striped northern palm squirrel (*Funambulus pennantii*) is also observed frequently consuming plant buds, fruits, seeds, grass, insects and other materials available from natural resources. The relative abundance of *R. rattus*, *M. musculus*, *B. bengalensis* and *S. murinus* is recorded as 86.67%, 10.31%, 2.43% and 0.60% in urban and 91.17%, 6.90%, 0.55% and 1.38% in the premises located in rural areas respectively (Fig. 2). Moreover, *R. rattus* and *M. musculus* are predominant pest in dwellings located in rural than urban areas. The rodent activity in these habitats is calculated by trap index (rodents/trap/day or rodents/100traps/day) and tracking markers census carried out in store rooms, kitchen area,

nearby sanitary holes and other potentially infested sites. The highest trap index (rodents/trap/day) 1.03 and 1.26, and lowest trap index 0.76 and 0.93 are observed in urban and rural sites respectively. Mean trap index  $0.85 \pm 0.05$  in urban and  $1.07 \pm 0.06$  in rural are recorded (Table-I). Simultaneously, tracking markers census experiments are also carried out by using white paper markers (20x20 cm) having marking ink coated polythene sheet (8x8 cm) in the central part of potentially infested places in the premises. In all, 13.34% to 50.00% and 30.00% to 60.00% positive track marks are observed in urban and rural domestic sites respectively. Mean of the positive track marks  $34.00 \pm 6.44$  and  $45.99 \pm 5.20$  are recorded in urban and rural sites respectively (Table-1).

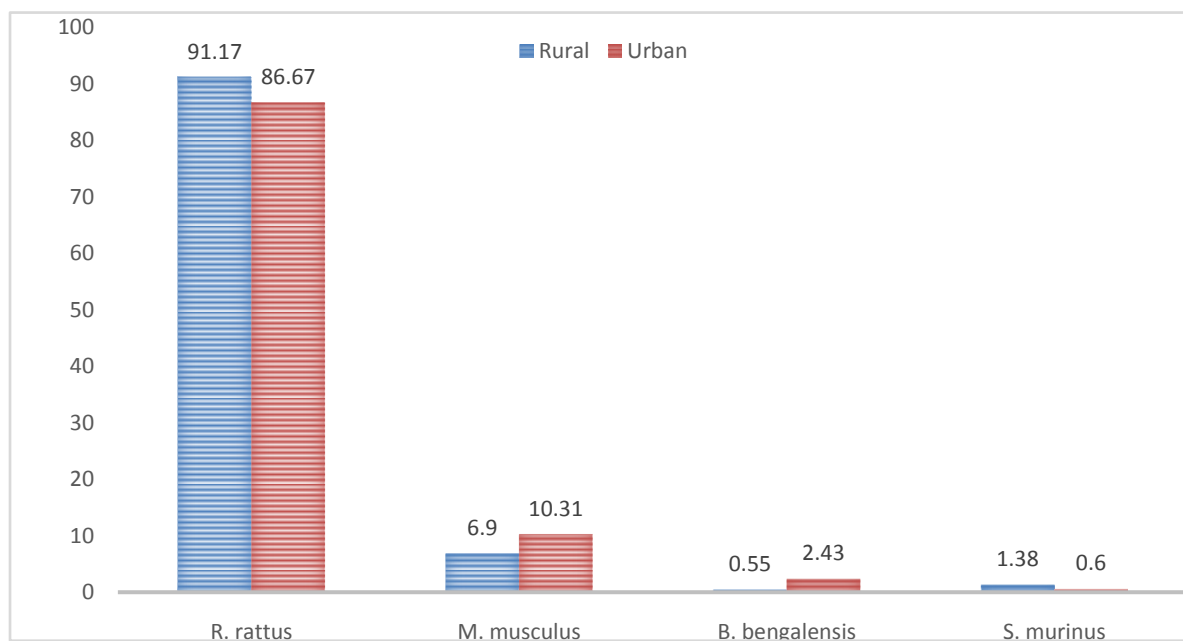


Fig. 2 Relative abundance of household rodent pest infestation.

In the same way bait census experiment is carried out in selected houses to estimate the level of rodent infestation. In bait census experiments, protected bait containers (32cm x 22cm x 32cm) are made from locally available empty tin boxes. The structure of the bait containers is specially designed so that the bait is accessible only to the rodents through three entrance channels. In each container, 500g of the bait is placed daily and the quantity of bait consumed each day is recorded for three consecutive days. The bait census (g/bait box/day) recorded during the study is varied from 9.63 to 14.20 and 12.75 to 16.08 in urban and rural domestic sites respectively. Mean of the bait census  $11.60 \pm 0.85$  is recorded in urban and  $14.48 \pm 0.59$  in rural houses (Table-1).

### RiskFactors of Rodent Infestation:

Rodents are reported to be most destructive pests in human dwellings and storage facilities in urban and rural regions of the country. Due to the presence of sharp incisors and their nocturnal habits which enable foraging activities to go largely within domestic setting and therefore, increasing the opportunity of stored food contamination and structural damage to various household articles.

Table-1 Level of rodent's activities in urban and rural situations.

Urban situations			
Study site	Trap index (rodents/trap/day)	Positive track marks (%)	Bait census (gm./bait box/day)
1	0.93	50.00	12.80
2	0.84	43.33	11.34
3	0.76	26.67	10.03
4	1.03	36.67	14.20
5	0.73	13.34	9.63
Mean ± SE	0.85±0.05	34.00±6.44	11.60±0.85
Rural situations			
1	1.20	53.30	14.55
2	0.93	30.00	12.75
3	1.26	46.67	13.64
4	0.96	60.00	16.08
5	1.03	40.00	15.39
Mean ± SE	1.07±0.06	45.99±5.20	14.48±0.59

Due to the burrowing, feeding, nibbling, urination and defecation activities, rodents pose potential threat to health of human beings and other live stocks through diseases they may carry. During the study, the house rat (*R.rattus*) and the house mouse (*M.musculus*) are found as most common commensal rodents in the domestic premises. These species are observed to live almost entirely inside the buildings and degrade the indoor setup. Positivity of contamination of various food commodities by rodent pests are observed as common indicators of degraded domestic premises environment (Table-2). In all, 50 samples of food

commodities (stored grains, fruits, vegetable etc.) are collected from each randomly selected urban and rural sites and examined for contaminated samples containing rodent droppings and hair, and nibbling activities. Scratching to various household articles i.e. door/windows, wire meshes, electric wires, plastic utensils/containers, paper/books and several other miscellaneous articles are also major risks observed in infested sites. Structural damage to plastic utensils and containers are observed in variable extent. In rural houses some of the plastic utensils and containers are damaged so badly that they are no longer put into use again. Even the door, windows and insulation of electrical wires in different equipment used in human habitation are observed to have structural degradation due to nibbling and gnawing habits of rodents.

Table-2 Risks assessment of rodent infestation in human dwellings.

Dwellings in urban area							
Study sites	%Contamination	Positivity (+) of structural damage or no damage (-)					
	Food commodities	Plastic utensil	Door/w indow	Furniture	Electric wires	Paper/ books	Miscell aneous
1	4.00	+	+	+	+	+	+
2	2.00	+	+	-	+	+	+
3	0.00	-	-	-	-	+	+
4	0.00	-	-	-	-	-	+
5	2.00	+	-	+	+	-	+
Mean ± SE		1.6±0.74					
Dwellings in rural area							
1	6.00	+	+	+	+	+	+
2	2.00	+	+	-	+	+	+
3	4.00	+	+	+	+	+	+
4	6.00	+	+	+	+	+	+
5	2.00	+	+	+	-	+	+
Mean ± SE		4.0±0.89					

## DISCUSSION

This study is performed to investigate the rodent pest diversity and various possible risk trends due to their infestation in human dwellings and storage facilities located in urban and rural environment. The periodic trapping record of rodent pest reveals that only two rodent species viz. the house rat *R. rattus* and the house mouse *M. musculus* are found to be the major pest species in domestic premises. As evident from relative abundance, the house rat, *R. rattus*, is reckoned to be the predominant rodent pest. (Fig. 2). Moreover, the trap index, track marks census and bait census experiments are performed to observe and identify the hot spots of these vertebrate pests' activities in domestic environment.



Fig. 3 Food contamination and structural deterioration of household articles.

It is found that the location of the habitat is known to influence the level of infestation of rodent pests. Residential premises established in urban are significantly less prone to rat infestation than rural. Data collection report indicating that the rate of rat infestation in rural properties is more likely because of the poor sanitation system i.e. open sewers, piles of garbage for disposal, and inadequate garbage collection services, and the construction works without any effective rodent-proof criteria. The entry points in urban houses are comparatively very few than in rural residential premises. This might be the reason of *R. rattus* being less abundant in urban residential premises than in rural ones. It is also observed that density of established premises is associated with rodent infestation. In both the cases,



high and low dwelling densities make an area prone to rodent infestation (Langton et al. 2001). Higher the dwelling density characterized by improper sanitation facilities and increased amount of garbage and rubbish may be one of the determinants of rodent infestation in rural area.

It is also known that the food habit is an important factor for attracting rodents in the given area and allow them to increase their population. The lesser bandicoot rat (*B. bengalensis*) is likely to be agricultural pest, but mostly captured in the premises used for green groceries (fruits and vegetables marketing sites). Such types of infestation sites are mostly available in urban localities, thus increased level of infestation. Besides, the nocturnal habit of rodents enables their foraging activities to go largely within domestic settings and therefore, increasing the opportunity food contamination and structural damage to various household articles (Fig.3). Positivity of contamination of various food items/commodities by rodent pests are considered as common indicator of degraded domestic premises environment.

Rodents are known to eat and contaminate the food material in residential area and making them unfit for use for human beings and other live-stock. Earlier findings have also reported the contamination of food samples due to rodent infestation in different situations from  $2.00\% \pm 0.71$  to  $6.00\% \pm 0.71$  (Chopra and Dhindsa 1987). The feeding, nibbling, urination and defecation activities of rat and mice may lead to pose potential threats to human health and other live stocks as they carry many vector borne diseases (Pingale et al. 1967; Barnett and Prakash 1975; Weber W.J. 1982). Their gnawing and nibbling activities are associated with structural damage to doors and windows, wire meshes, furniture and insulation of electrical wires (Table-2). This may lead to aesthetic deprivation and sometimes short-circuiting and fire hazards of domestic properties.

## CONCLUSION

In conclusion, this study has main focus on the need of further investigation and selection of various environmental as well as design factors which are significantly associated with rodent pest infestation in domestic premises, especially in rural area. Huge economic nuisance due to rodent infestation is reported in rural dwellings because of deficient sanitation system due to low socio-economic status, improper handling of food items and negligence of rodent proofing criteria during construction work of buildings. Therefore, it would also be interesting to take into consideration the possible link between building design, storage of food commodities and rodents infestation. In this way, our risks assessment data collection report may prove important implication for future rodent pest management strategy applicable in domestic environment.

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