

Original Article

## Distribution of commensal rodents in some shops of three districts in Malakand region, Pakistan

Distribuição de roedores comensais em algumas lojas de três distritos na região de Malakand, Paquistão

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### Abstract

Using wire mesh live traps distribution pattern of the *Rattus rattus* and *Mus musculus* in different shops of three districts of Malakand region, Pakistan were recorded from September 2014 to October 2015. Over all 103 rodents (*Rattus rattus* 86 and *Mus musculus* 17) were caught during in 0.04 trap success (2448 trap nights). Regression of daily captures on cumulative captures revealed an estimate of 103 rodents from all the sampled structures with an average of 3.55 rodents per shop. *R. rattus*; 83.4% of captures were numerically dominant in almost all types of shops sampled, and were significantly different than *Mus musculus*; 16.5% of captures. Both species were found together in some shops while they were mostly trapped from the separate shops. Male rodents outnumbered the females.

**Keywords:** synanthropic rodents, vertebrate pests, house rats, trap nights, Malakand-Pakistan.

### Resumo

Usando o padrão de distribuição de armadilhas vivas de malha de arame do *Rattus rattus* e *Mus musculus* em diferentes lojas de três distritos da região de Malakand, o Paquistão foi registrado de setembro de 2014 a outubro de 2015. No total, 103 roedores (*Rattus rattus* 86 e *Mus musculus* 17) foram pegos durante em 0,04 armadilha de sucesso (2448 noites de armadilha). A regressão das capturas diárias em capturas cumulativas revelou uma estimativa de 103 roedores de todas as estruturas amostradas, com uma média de 3,55 roedores por loja. *R. rattus*; 83,4% das capturas foram numericamente dominantes em quase todos os tipos de lojas da amostra e foram significativamente diferentes do *Mus musculus*; 16,5% das capturas. Ambas as espécies foram encontradas juntas em algumas lojas, enquanto estavam na maior parte presas em lojas separadas. Os roedores machos eram mais numerosos do que as fêmeas.

**Palavras-chave:** roedores sinantrópicos, pragas de vertebrados, ratos domésticos, noites de armadilha, Malakand-Paquistão.

### 1. Introduction

Rodents have persisted a key factor in the human experience and philosophy since centuries. Rodentia is composed of 1/4<sup>th</sup> of the reported mammal species (Roberts, 1997). Forty three rodent species have been reported in Pakistan (Beg et al., 1979). Three species of rodents including

*Rattus rattus*, *Rattus norvegicus* and *Mus musculus* have been considered synanthropic importance (Aplin et al., 2003; Cavia et al., 2009). *R. rattus* is cosmopolitan in distribution and originally it is South East Asian murid (Meehan, 1984). In Pakistan *R. rattus* is an indoor species of rodents

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(Roberts, 1997). A large number of *R. rattus* have been observed in grain markets of Rawalpindi, Punjab, Pakistan (Ahmad et al., 1995), however they were not sure on the presence of *R. norvegicus* in the study area. It has been estimated that on an average, a grain shop harbored up to 40 rats resulted an estimation 4000 metric tons annual loss of grain in Punjab, Pakistan.

Synanthrops nature of rats and mice has a key role in transmitting infections of great zoonotic importance (Yasuraoka et al., 1996). Over 60 known diseases have been reported to be transferred from rodents to humans and the number is still increasing day by day as more and more research on zoonosis (Khatoon et al., 2004). Owing to their importance as public health hazard, rodents borne diseases like rat bite fever, murine typhus, leptospirosis, toxoplasmosis, trichinosis, salmonellosis and the plague have accounted for the death of more than 20 million people (WHO, 2007). A large part of human population in Pakistan has suffered from high exposure to rodent attacks as they live in squared and slum areas.

Present study was aimed to provide information regarding pattern of distribution of commensal rodents in different shops in three districts of Malakand region, where studies on dispersal pattern and abundance of rodent pests are lacking. Such studies will help policy makers to plan for controlling of rodent pests in agricultural ecosystem and in stored products.

## 2. Materials and Methods

### 2.1. Study area

This study was conducted in different shops of different areas of district Malakand, district Lower Dir and district Swat. They lies 34° 22' and 35° 50' North and 71° 02' and 72°30' East and 34°34' to 35° 55' North and 72° 08' to 72° 50' East which are situated towards North of the province of Khyber Pakhtunkhwa. The current study was carried out from September 2014 to September 2015.

The climate of the area is dry. It has hot summer and cold winters. The annual average maximum and minimum temperatures are about 29 °C and 12 °C respectively. The annual rainfall varies between 600 mm to 1100 mm. The rainfall is erratic, mostly received in monsoon that is July – August. Snowfall is much rare and seldom occurs on the tops of some mountains, which is again followed by immediate melting. Frost commonly occurs and starts by the mid of the November. The overall weather is extreme. Agriculture is the prime most and live – stock is second in number for living.

### 2.2. Trapping of rodents

A total of 179 locally available commercial wire mesh live traps of medium size were used for rodents capturing. During capturing the rodents each of the traps were baited with oily bread, which are gamely attractive by the rodent pest. A total of 3 to 4 shops were selected randomly for indoor trapping at each locality. The number of traps allocated at each shops ranges 4-24 traps for 3 consecutive

days in the evening and picked up in the morning. Traps were set where signs of rodent movements were recorded particularly against the wall. Month wise trapping was carried out in each sampled locality.

### 2.3. Trap success

Population abundance of the rats trapped were calculated by applying the following Formula 1:

$$\% \text{ trap success (abundance)} = \text{Number of rodent trapped} / \text{Number of trap nights} \times 100 \quad (1)$$

### 2.4. Anesthetization of the rodents

All the live captured specimens of rodents were anaesthetized with chloroform and the following information were reported.

### 2.5. Visualizing the age by

#### 2.5.1. Weight of the body

Each of the rodent specimens were weighed by using the Precisa balance model No.18220 Switzerland.

#### 2.5.2. Rats and mice specimen age

On the bases of body weight rats were divided in to two age groups: Juvenile: < 55 grams for males and females, adults: < 200 grams for males and < 100 grams for females.

#### 2.5.3. Rats and mice specimen sex

Based on inspection of sexual organs via naked eyes, the sex was determined as: male; when the ano-genital distance was measured usually greater and in female; when the ano-genital distance was measured usually less than male.

## 3. Results

A total of 103 rodents were captured including 83.4% (*Rattus rattus* =86) and 16.5% (*Mus musculus*=17). The majority of rats as well as mice were trapped at Swat district and less were trapped at lower Dir district (Chakdara). House rats (*Rattus rattus*) were trapped at all sites except dry fruit shops while house mice (*Mus musculus*) were not trapped only at sweet shops and fruit shops. Rats were usually trapped during all the seasons of the year except spring and summer in Malakand and Lower Dir district (Chakdara) while mice were trapped only during autumn and winter seasons (Table 1).

### 3.1. Abundance of commensal rodents

The population abundance indices of *Rattus rattus* (n=86) was greater than *Mus musculus* (n=17) and was statistically significant (P value 0.0007 with 95% confidence of interval 5.089 to 14.63) among habitats. *R.rattus* was the species that numerically predominant in every habitats while *M. musculus* were also trapped in some of the sampled habitat, including grocery shops, bakeries and sweet shops, grain godowns, rice godowns,

**Table 1.** Distribution pattern of rats and mice in different shops of three districts Khyber Pakhtunkhwa, Pakistan from September 2014 to October 2015.

Districts	Locality	Shop type	NOSs	NOTs	Nights	TNs	Captures/night			TNRCs	TS	NRCs
							I	II	III			
<b>Malakand</b>	Batkhela	Grocery stores	1	09	12	108	1	0	0	1	0.009	1
		Bakeries/Sweet shops	1	09	15	135	2	1	1	4	0.029	4
		Grain godowns	2	12	09	90	0	2	1	3	0.03	1.5
		Rice godowns	1	06	18	108	3	2	2	7	0.06	7
		Fruit shops	1	08	09	72	2	0	0	2	0.02	2
		<b>Sub-total</b>	6	44	63	513	8	5	4	17	0.03	2.83
	<b>Mean±SD</b>	1.2±0.44	8.8±2.16	12.6±3.91	102±23	1.6±1.14	1±1	0.8±0.8	3.4±2.30	0.02±0.01	3.1±2.45	
<b>Dir district (Lower)</b>	Chakdara	Sweet shops	1	09	06	54	0	0	1	1	0.01	1
		Butcher shops	1	07	15	105	9	0	0	9	0.08	9
		Bakeries	1	04	18	72	0	1	1	2	0.028	2
		<b>Sub - total</b>	3	20	39	231	9	1	2	12	0.05	4
		<b>Mean±SD</b>	2.5±2.38	11.7±8.7	14.2±4.5	177±1.7	2.25±0.35	2.25±1.25	1.5±1.73	6±3.65	0.04±0.03	3.08±1.70
		Ouch	Rice godowns	6	24	18	432	3	2	3	8	0.01
<b>Swat</b>		Grocery stores	2	12	09	108	3	4	3	10	0.09	5
		Bakeries	1	05	12	60	1	1	0	2	0.03	2
		Sweet shops	1	06	18	108	2	2	0	4	0.03	4
		<b>Sub - total</b>	10	47	57	708	9	9	6	24	0.03	2.4
		<b>Mean±SD</b>	1±0	6.66±2.5	13±6.24	77±25.8	3±5.19	0.33±0.57	0.66±0.5	4±4.35	0.03±0.03	4±4.35
		Matta	Grocery shops	1	10	09	90	1	0	1	2	0.22
	Bakeries stores	2	14	18	252	4	4	4	12	0.04	6	
	Grain godowns	2	14	09	126	3	5	2	10	0.07	5	
	Rice godowns	1	8	12	96	2	1	3	6	0.06	6	
	Super stores	2	12	21	252	1	0	4	5	0.01	2.5	
	Fruit shops	2	10	18	180	8	4	3	15	0.08	7.5	
	<b>Sub - total</b>	10	68	102	996	19	14	17	50	0.05	5	
	<b>Mean±SD</b>	1.66±0.51	11.3±2.42	14.5±5.16	166±73.8	3.16±2.63	2.33±2.25	2.83±1.16	8.33±4.84	0.08±0.07	4.83±2.16	
	Grand total	29	179	261	2448	45	29	29	103	0.04	3.55	

**Abbreviations:** NOSs: Number of shops; NOTs: Number of traps; TNs: Trap nights; TNRCs: Total number of rats captures; TS: Trap success.

fruit shops, super stores and Butcher shops. *M. musculus* were usually considered in-house species, where rats are not in abundance. *R. rattus* came to be the most abundant in rice godowns in Batkhela-Malakand, in Butcher shops in Chakdara Lower Dir, in rice godowns in Ouch-Lower Dir and in fruit shops in Matta-Swat. Population density of rats and mice in three districts was not statistically significant (P value 0.0628 with 95% confidence interval -1.967 to 47.97) (Figure 1).

3.2. Sex ratio and seasons

Males were trapped more (n=62) than females (n=41) in both the species but not statistically different (P value 0.5375; with 95% confidence interval range -14.40 to 24.90). Sex ratio: 1.3:1.0 and 3.25:1 male and female in rats and mice were regarded in all the shops studied.

Present data reveals the season wise population abundance for rats and mice as: 7,0; 6,0; 42,7; 31,10 were trapped during autumn, winter, spring and summer respectively but not statistically different (P value 0.1130 with 95% confidence interval -5.506 to 40.01). Locality wise the population abundance of the rodents trapped was: 17 (16.5%), 36 (34.9%) and 50(48.5) in Malakand, Lower Dir and Swat districts. The majority of the rats were trapped at the Swat district during autumn while no rat was trapped during spring and summer at districts Malakand and Lower Dir except 2 male rats were trapped during spring in Ouch-Lower Dir district. Same number of the mice were trapped during winter in Malakand, Ouch-lower Dir district and Swat while no mouse was trapped during spring and summer at all the localities. Population density of rats and mice in different seasons of the year was not statistically significant (P value 0.0628 with 95% confidence interval range -1.967 to 47.97) (Figure 2).



Figure 1. Distribution of rodents in different shops of 3 districts (Swat, Lower Dir and Malakand) of Khyber Pakhtunkhwa, Pakistan.

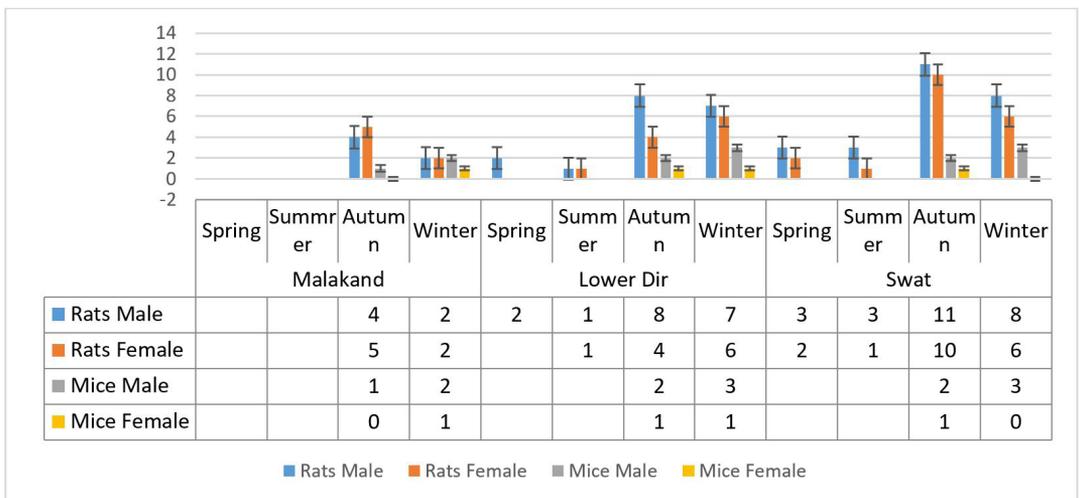


Figure 2. Variation in population dynamics of rodents (*Rattus rattus* and *Mus musculus*) in different seasons of the year.

#### 4. Discussion

Zoonotic infections have a number of linkage between host and parasite. Close interaction of rodent with humans creates a leading threat to human life. Commensal rodents are the transmitting agents of a large number of zoonotic pathogens to humans and their live-stock through urine, feces, aerosols and ectoparasites. Rodents make the environment suitable for maintaining the population become active (Belmain et al., 2002; Pocock et al., 2004). The richness of *R. rattus* in the study area could be due to the availability of food and place, which may therefore attract these murids. *Rattus rattus* was the richest species in the sampling area, supporting the findings of Castillo et al. (2003), Hancock (2008), Gomez et al. (2009), Sidorov and Putin (2010) and Mushtaq et al. (2014). The overlapping of the *R. rattus* species in grocery shops and in grain godowns 44.8% (13/29 shops have observed, while in all the cases, *R. rattus* were recorded as 83.4% (86/103). *R. rattus* had a higher relative proportion than *M. musculus* 16.5% (17/103) Figures 1 and 2.

Rodents have an enormous economic impact on stored grain in developing countries. It has been estimated that the annual loss of food due to rodents is about 11 kg/person. This value is equal to the combined gross national product of 25 kg/person of the poorest nations (Gwinner et al., 1996).

Impact of different species of *Rattus* and *Mus* on storage facilities frequently has been documented by (Buckle and Smith 1994; Hofp et al., 1976) in various countries as: up to 10% in Laos and Malaysia (Muda, 1986) 5% in Thailand, 5% in Phillipines (Caliboso et al., 1986), 20% in Korea (Sidik et al., 1986).

Regarding sex ratio of the specimens' males 1.3 and 1 were more captured than females 1.0 and 1 in rats and mice respectively in the current study. Sex ratio reflects the capability of the species respond to natural selection (Wu et al., 2006). The availability of food in abundance favor the 1:1 sex ratio in polygamous species (Wright et al., 1988). Current research favor this phenomenon in some extent for *R. rattus*, however in *M. musculus* the sex ratio is different from 1:1 with higher recorded capture of males. Kunimoto et al. (2002) recorded 2.1: 1 male-female ratio in population of *M. musculus* in Peru while Gomez et al. (2009) reported variation in the sex ratio in the same species in different areas and seasons in Argentina. Occupying areas in search of food by the females with which to mate with males but are commonly resisted by dominant males, which leads to an increased possibility of captures. During reproduction the females do not go away from their nests and their areas of activity becomes limited than males as they usually busy in nursing their young's particularly in pregnancy and lactation (Hernández-Betancourt et al., 2003; Frynta et al., 2005). Further, wild populations have a clear reproductive periodicity (Singleton et al., 2001), while commensal rodents' exhibits no such reproductive seasonality. The reproductive seasonality in rodents may due to the availability of optimal conditions for reproduction (Sidorov and Putin, 2010) and the aggressiveness of the adults lead to make low rate of young individuals of both species (Drickamer et al., 1999) hence the rodents takes very short time to attain their sexual maturity. All of the

trapped rats and mice were adults while no sub-adults or juveniles were found to be trapped, which an accordance to the work cited above is.

According to Brooks et al. (1994) and Mushtaq et al. (2014) no rat proof mechanism was seen. A similar situation was observed during the present investigation; most of the shops were found heavily loaded with the food items, which may be provide excellent habitat for placing the rodents. The stored food materials and the deposition of waste may provide supreme opportunity to increase the number of rodents. This situation may lead the lack of sanitation, contamination of food items by the rodent excreta which may be easily transferred to human on consumption. Same studies have also been documented by Childs et al. (1998), Lambropoulos et al. (1999) and Pocock et al. (2004). The rodent infestation represent in high health risk. Presence of rodents near human settlements indicate zoonotic disease transmission (Castillo et al., 2003).

Current research is the first attempt to scrutinize populations of commensal rodents in different study structures of three districts of Malakand region, which picture the possible health hazards to inhabitants of the area. This study yield evidence for knowing the risk due to these rodents to the public health. Further research is needed for the effective dealings to reduce rodent populations.

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