Pak. J. Agri. Sci. Vol. 36 (3-4), 1999

INHIBITING RODENT DEPREDATIONS. 11. DISTRIBUTION AND ABUNDANCE OF RATS AND MICE IN A WHEAT-SUGARCANE BASED CROPLAND

Durr-i-Shahwar, Mirza Azhar Beg, Muhammad Mushtaq-ul-Hassan & Akbar Ali Khan
Department of Zoology and Fisheries, University of Agriculture, Faisalabad

This study on the distribution and seasonal changes in the density of rats and mice populations in a 100-acre block of the wheat-sugarcane based cropland of central Punjab extended from August 1993 to June 1994. Four species of rodents viz. the lesser bandicoot rat, the house mouse, the field rat, and the Indian gerbil were recorded from this block. These rodents achieved high prevalence of pregnancy and produced larger litters during the spring season and ceased to reproduce during the winter season. In the study block, where multiple-cropping was practised, food and shelter conditions changed abruptly and frequently. As a result, there took place frequent dispersals and concentrations in the rodent populations. The concentrations of these pest populations in only the sugarcane fields which form 15% to 20% of the total farmlands, offered an excellent opportunity in October and January for protecting the cane and wheat crops from the rodent depredations at a relatively low cost and with a little ecological disturbance.

Key words: abundance of rats and mice, control, distribution, wheat-sugarcane based cropland

INTRODUCTION

A block of cropland about 100 acres in size located near Dharoar (61 J. B.) village about 15 km-west of Faisalabad city (Punjab), was chosen for the purpose of this study. In this canal irrigated cropland wheat. was the main crop as it occupied about 60% of the' total land area of the study block. Sugarcane and fodder crops (both graminoid and leguminoid types) were the two other important crops d'fthis block. The cropping practice of this study block may be taken to represent that of the wheat-sugarcane based croplands of the central Punjab. This paper presents information on the abundance, inter-crop movements and distribution of rats and mice in a wheat-sugarcane based cropland in Faisalabad district of the province of Punjab.

MATERIALS AND METHODS

The studies on distribution and seasonal changes in the abundance of rats and mice in a wheat- and sugarcane-based cropland of the central Punjab extended from August, 1993 to June, 1994. The study block, 100 acres in size, was located about 15 km west of Faisalabad city near village 61 J. B. The cropping pattern of the study block approximated that of the most of the central Punjab (Fig. 1). The crops of the study block comprised wheat, sugarcane, graminoid (viz. maize, millet and sorghum) and leguminoid (viz. lucern, clover and shaftal) fodder crops, cotton and a variety of vegetable crops. Among the vegetable crops potato and onion were predominant.. During each of the 11 months of this study, a number of fields under different crops were selected randomly, whenever possible, for taking samples of rats and mice. Each month trapping was conducted for five consecutive nights in the selected fields. Each acre of the selected fields was served with 10 and 5 traps for rats and mice, respectively. The pattern of setting the traps was the same as described in Durr-i-Shahwar et al. (1999). The captured animals were autopsied for obtaining necessary information on reproduction.

RESULTS

Distribution and Abundance: Four species of murid rodents were recorded from this study block. They were the lesser bandicoot rat *(Bandicota bengalensis),* the house mouse *(Mus musculus),* the soft-furred field rat *(Rattus meltada),* and the Indian gerbil *(Tatera indicai.*

Wheat Fields: In central Punjab sowing of the wheat crop begins in October and continues through December. The reason for delayed sowing till December is intensive cultivation; two to three crops are grown each year from most of the fields. Fields cropped to sugarcane and cotton are available for wheat sowing late in the season. The wheat crop begins to mature in March and ripens in April. Harvesting starts by the later half of April and continues through the first half of May. During the period of this study the wheat crop in the study block was sown in November and December. Randomly selected wheat fields were sampled each month for rats and mice from January, 1994 through June, 1994. The June trapping was done in a harvested

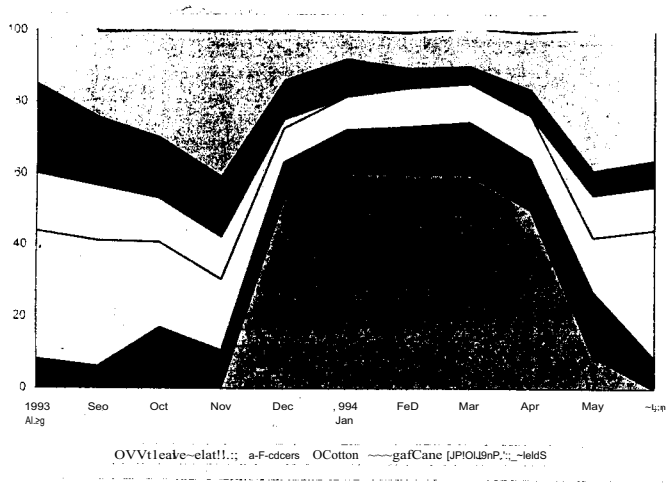

Fig. 1. Monthly variation in the vegetation ~ovp.r in thp. stnClv hlo~k

wheat field. During the six months of sampling, a total of 20.5 acres of wheat fields was sampled using 1535 trap nights.

The bandicoot rat was present in all the six monthly samples except in that of January. Trap success for this rat was relatively high in March, April and May, that is, during the pre-maturation, maturation, and ripening and harvesting periods of the wheat crop, the respective trap success being 2.14%, 3.20% and 1.82% (Fig. 2a). The house mouse was represented in all the monthly samples except in that of the June. Its trap success ranged from 1.33% in April to 5.45% in May. The mouse's abundance peaked in February and May. The former coincided with the tillering time and the latter with the harvesting and post-harvesting time of the crop. The May trapping was done in a 1.5 acre field which had not yet been harvested. The soft-furred field rat and the Indian gerbil were recorded only in, the samples of February and March, and February and April, respectively (Fig. 2a). Although the combined abundance of all the four species in the wheat crop remained high from February through May, yet relative abundance of the individual species varied from month to month (Fig. 2). During the tillering phase (February) of the wheat crop, high abundance was mainly due to house mouse and the field rat which jointly accounted for about 86% of the total trap success. During the maturation phase (March) the house mouse contributed 41% of the total trap success, whereas the field rat and bandicoot rat contributed 31% and 28%, respectively. The picture greatly changed during the ripening season (April) when the field rat was not represented in the sample, the Indian gerbil reappeared in a relatively larger number, and the bandicoot rat became the most dominant species in the sample. During the harvesting (second half of April and first half of May) and post-harvesting (second half of May) periods, species diversity in the wheat fields declined as only house mouse and bandicoot rat were represented in the samples. The June sample comprised just one species of the bandicoot rat.

Sugarcane Fields: The cane crop constitutes the most stable subhabitat in the croplands as it stays in the field almost round the year. In the present study block this crop was grown over about 25% of the total land area. The acreage of this crop started shrinking from October when its harvesting continued thereafter for a prolonged period of time. By the late spring only scattered small patches of the crop were left in the fields for use as seed.

The sugarcane fields appear to be a favourite habitat of the bandicoot rat, the field rat, and the house mouse who infested them heavily for the greater part of the year (Fig. 2b). The gerbil was recorded from the cane fields only occasionally. The pattern of the rise and fall in the population densities of the above three species in the cane fields was different. The field rat was the first species to achieve peak abundance in September - October, the house mouse in October, and the bandicoot rat in November (Fig. 2b). The first two species became rare in the cane fields after December (1993). However, in May (1994), following the harvesting of the wheat crop, the populations of these two species peaked again. But, the bandicoot rat population evidenced only a perceptible increase. The combined rodent abundance in the cane fields started improving right from August and reached a peak in October and then gradually declined. During March and April these murids had almost abandoned the cane fields. But in May the field rat and the house mouse reappeared in relatively large numbers (Fig. 2b). The gerbil was recorded from the cane fields only occasionally.

Fodder Fields: The fodder crops were present in the study block almost round the year. During the summer and greater part of the fall, graminoid fodder crop covered up to 36% of the total area of the study block. The area under the leguminoid fodder crop was relatively small as it did not exceed 11% of the total land area. The bandicoot rat seems to have very little liking for the fodder crops; it constituted only 8% of the total catch from the fodder fields. The house mouse and the field rat were the two predominant species in the fodder fields as they constituted 57%

Table 1. Prevalence of pregnancy and embryonic litter size in samples of murid rodents captured from the Faisalabad study block and from the nearby cropland

Season	No. of adult females	Pregnant females (%)	Litter size Mean± S.D.
		B. bengalensis	
Winter	7	14.3(1)	9.0
Spring	27	59.2(16)	8.7 ± 2.59
Summer	23	47.8(11)	5.7 ± 1.91
Fall	15	40.0(6)	5.0 ± 1.91
		M. musculus	
Winter	11	18.2(2)	7.5 ± 0.50
Spring	53	54.7(29)	8.9 ± 1.76
Summer	40	60.0(24)	6.1 ± 1.98
Fall	30	43.3(13)	6.3 ± 1.50
		R. meltada	
Winter	25	8.0(2)	7.0 ± 0.00
Spring	23	69.6(16)	7.1±1.52
Summer	53	62.3(33)	4.9 ± 1.28
Fall	37	32.4(12)	6.4 ± 0.86
		T. indica	
Winter	39	10.2(4)	5.0 ± 2.74
Spring	44	52.3(23)	7.5 ± 2.08
Summer	31	25.8(8)	6.7 ± 0.97
Fall	28	21.4(6)	5.7 ± 1.37

Table 2. Average trap success (of all the trapping months of the individual crop) of rats and mice in various fields of the Faisalabad study block

Crop/ habitat	Trap nights	Trap success (%) (No. of animals caught) Rb.	M.m.	Rm.	T.i.	Total
Wheat	15:35	1.56(24)	2.80(43)	0.85(13)	0.59(9)	5.80(89)
Sugarcane	1385	4.98(69)	5.05(70)	5.92(82)	0.22(3)	16.17(224)
Fodder	1985	0.91(18)	6.65(132)	3.63(72)	0.50(10)	11.69(232)
Cotton	935	0.11(1)	4.92(46)	3.21(30)	1.60(15)	9.84(92)
Vegetables	975	0.10(1)	3.69(36)	1.44(14)	0.21(2)	5.44(53)
Tot./Av.	6815	1.66(113)	4.83(329)	3.10(211)	0.57(39)	10.12(690)

B.b.= *Bibengalensis,* M.m.= *M.musculus,* Rm.= *R.meltada,* T.i.= *T.indica*

and 31% of the total catch. The former species was much better represented in the samples collected from August through December and the latter one from August through October (Fig. 2c). Thus, these two species inhabited the fodder fields mainly during late summer and fall.

Vegetable Fields: Depending on the season, the area of the vegetable fields varied from 1% to 18% of the total land area of the study block. A variety of crops comprising potato, tomato, okra, onion, radish, carrot and red pepper were grown in small scattered fields of varied sizes. The house mouse and the field rat were numerically dominant species in the vegetable fields. They constituted respectively 68% and 26% of all the specimens captured from these fields. These two species inhabited the vegetable fields mainly during late summer and fall (Fig. 2d). The bandicoot rat and the Indian gerbil were captured here only occasionally.

Cotton Fields: In central Punjab the cotton crop is sown in late May and June and is generally removed from the fields during November and December. A maximum of 16% of the study block was under this crop. The cotton fields were sampled for the rodents from August through January. Of the 92 specimens, the bandicoot rat was represented just by a single

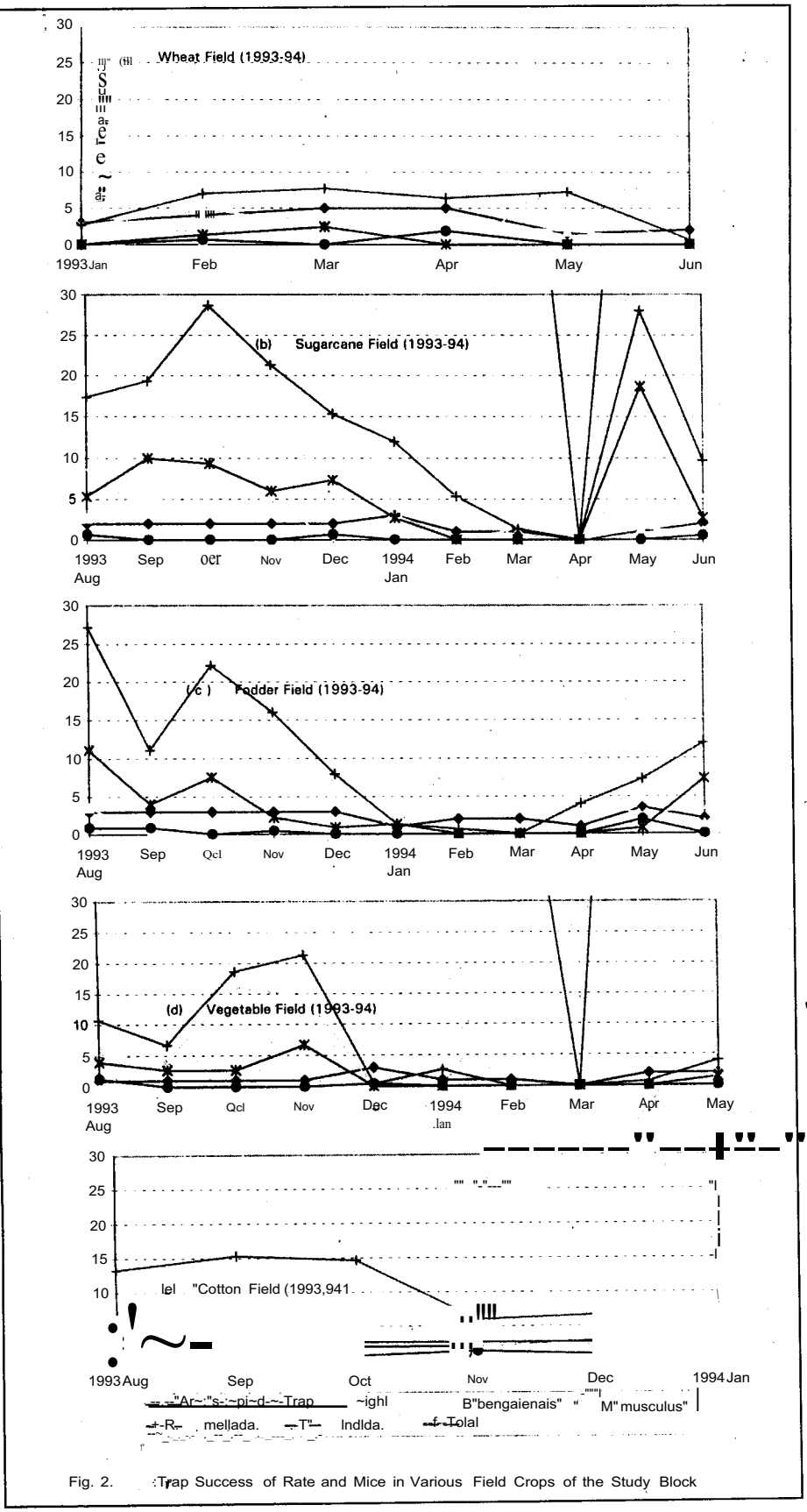

Fig. 2. Trap Success of Rate and Mice in Various Field Crops of the Study Block

specimen. The house mouse was the most "dominant species with a relative abundance of 50%. It was followed by 33% of the field rat and 16% of the Indian gerbil. The latter was mainly caught in August and September. The house mouse and the field rat were captured from the cotton fields mainly in late summer, fall and early winter (Fig. 2e).

Reproduction: Table 1 documents information on the prevalence of pregnancy and embryonic litter size in the seasonal samples of the four rodent species. Pregnant females of *B. bengalensis* were present in all the four seasonal samples. The lone pregnant female present "in the winter sample was captured in February and was at an early stage of pregnancy. The prevalence of pregnancy was the highest in the spring, less in' the summer, lesser in the fall and the least in the winter season. Larger embryonic litters were encountered in late winter and spring than in summer and fall. In the case of *M. musculus,* the prevalence of pregnancy was the lowest in the winter sample and the maximum in the summer "sample. In the remaining two seasons, the proportion of pregnant females was two to three folds greater than that of the winter season. The winter and spring litters were larger in size than the summer and fall litters. The seasonal variations in the prevalence of pregnancy in *R. meltada* and *T. indica* followed the pattern described for *B. bengalensis,* that is, it peaked in the spring and then continually declined through summer, fall and winter. The former species produced larger litters in winter and spring and the latter in spring and summer.

All the four species exhibited low prevalence of pregnancy during the winter months. Excepting the house mouse, pregnant females of the rats and the gerbils were caught mainly in the second half of February. All the four species attained high prevalence of pregnancy and produced larger litters during the spring season when there was a surfeit of food and shelter in the wheat fields; the house mouse attained the highest prevalence of pregnancy during the summer.

DISCUSSION

In the wheat-sugarcane based study block, four species of rodents viz. the bandicoot rat, the house mouse, the field rat, and the Indian gerbil were present. The house mouse was numerically the most dominant species. It outnumbered all the other species in all the crops except in the sugarcane fields where the field rat predominated (Table 2). The average trap success (for the five crops) for the house mouse alone exceeded the combined trap success of all the other species. The next most dominant species was the field rat which eo-shared dominance with the house mouse in the cotton, fodder, vegetable and cane fields. The bandicoot rat achieved maximum abundance in the cane fields where it approximated that of the house mouse and the field rat. In the wheat fields, it was the most abundant species after the house mouse. The Indian gerbil infested the cotton fields intensively. In the vegetable and sugarcane fields it occurred only occasionally.

Thus, the rodent infestation in the cotton fields was mainly due to the house mouse and the field rat; in the wheat fields due to house mouse and the bandicoot rat; in the fodder fields due to the house mouse and the field rat; in the vegetable fields due to the house mouse and the field rat and in the cane fields due to the field rat, the house mouse and the bandicoot rat (Table 2). The overall abundance of the rodents in the present study block was approximately three times larger than that of the wheat-rice based cropland at Alipur (Durr-i-Shahwar, 1999). The difference was due to much higher abundance of the house mouse and the field rat in the former and absence of the Indian gerbil in the latter.

The murid populations inhabiting the study block generally achieved high prevalence of pregnancy and produced larger litters during the spring season. In all the four species, the prevalence of pregnancy in the fall was much smaller than what they achieved during the spring and summer seasons. Also, the size of litters produced during the fall was generally comparable with that of the summer. In contrast, the bandicoot rat and the house mouse of Alipur Chatta achieved high rate of reproduction during the spring and fall seasons (Durr-i-Shahwar, 1999). The field rat, however, attained high levels of prevalence of pregnancy during the summer and fall seasons. But this difference may easily be ascribed to the smallness of the samples. Relatively higher rates of reproduction in the murid populations of this study in the spring and in the fall in Alipur Chatta were seemingly related to the better food and shelter conditions available in the wheat fields of the former area (in the spring) and in the wheat and rice fields of the latter area (in spring and fall). Another point which needs to be noted here is that the duration of the winter quiescence period in reproduction especially in the case of the bandicoot rat and the field rat populations of the Alipur cropland (Durr-i-Shahwar, 1999) was longer than recorded for these two species from the present study area. Although a number of factors might have been responsible for this disparity, yet it may be kept in view that in Sindh these species are known to breed almost round the year (Smiet et al., 1980; Fulk et al., 1981), while in central Punjab around Faisalabad they are reproductively quiescent for a greater part of the winter (Beg, 1986). Further north around Alipur where the winter months are colder, the two rat species seemingly cease to breed completely during these months. A more northern population of the bandicoot rat around Islamabad breeds just for six months of the year i.e. from April through September (Hussain, 1989).

Control Implications: In the wheat-sugarcane based agroecosystem of central Punjab multi-cropring is a common practice where food and shelter conditions change abruptly. When a crop is re dered inhabitable due to depleting food and helter resources, the rats and mice have available to them alternate fields of variable size to sustain them. Consequently, there is a frequent dispersal and concentration of the murid populations. At certain times of the year they are forced to concentrate in crops whose acreage is small. Such densely populated fields offer excellent spots for destroying the rodent concentrations at a relatively low cost causing a little ecological disturbance.

In the wheat-sugarcane based croplands of central Punjab, wheat and sugarcane are the crops which suffer most of the rodent depredations. Following harvesting of the cotton and the fodder crops, and parts of the sugarcane crop, and subsequent preparation and sowing of the harvested fields to wheat and leguminoid fodder crops during October-December, the rodents find shelter in the unharvested

cane fields. As the harvesting of the cane fields progresses, further concentration of rats and mice populations takes place in the remaining stands of the cane crop till better food and shelter conditions are available in the wheat fields (Fig. 2). The bandicoot rat, the field rat, and the Indian gerbil stop breeding during December and January, while the house mouse decelerates the process of reproduction greatly during these months. Consequently, the rate of growth of these murid populations slows down and finally becomes negative, at least, in the first three species. The cane fields harbouring concentrations of the murid populations are the ideal sites for destroying them (Fig. 2). These species, which start attacking the sweetening canes in October, heavily depend on them for their food during the colder months of the years (Smiet et al., 1980; Beg et al., 1992; Beg and Khan, 1994). It is here in the cane fields that they must be killed using appropriate rodenticidesin October. In central Punjab, the area under this crop averages 15% to 20% of the total farmlands. Poison baiting in the cane fields should be repeated in January before the nucleus rodent populations with high reproductive potential disperse to the vast area under the wheat fields.

The poison baitings in sugarcane fields in October and January will deplete the bandicoot rat, field rat and the house mouse populations to an extent that they will cease to be a significant threat to the cane crop as well as to the wheat crop. As the poison baitings will be confine.d to a relatively small area under the cane crop, it will cause minimum ecological disturbance and will hopefully be cost effective. However, this method will not be effective against the Indian gerbil as it affects the cane fields only sparingly.

REFERENCES

Beg. M.A 1986. Ecology of rats and mice in the agroecosystem of Punjab. Proc. 6th Pak. Congr. Zool.pp. 1-13.

Beg, M.A, AA Khan, S.A Rana and M. Mushtaq-ul-Hassan. 1992. Food habits of *Mus musculus* in a sugarcane, wheat and fodder-based agro-ecosystem of Faisalabad. Pak. J. Zool. 24(2): 157-161.

Beg, M.A and AA Khan. 1994. Development of an environmentally responsible strategy for managing rats and mice populations in a canal irrigated agroecosystem of central Punjab. Promotion of Research Grant, Univ. Agri., Faisalabad: 77

Durr-i-Shahwar, M. A Beg, M. Mushtaq-ul-Hassan and A A Khan. 1999. Inhibiting rodent depredations. 1.. Distribution and abundance of rats and mice in a wheat-rice based cropland. Pakistan J. Agri. Sci. 36(3-4) 115-121.

Fulk, G.W., AC. Smiet and AI<. Khokhar. 1981. Movements of *Bandicota bengalensis:* and *Nesokia indica* in rice fields in Sindh. J. Bombay Nat. Hist. Soc. 78(1): 107-112.

Hussain, 1.. 1989. Effect of diet and:' seasonal variations on the reproduction of the Bandicoot rat, *Bandicota bengalensis.* M. Phil. Thesis. Quaid-i-Azam Univ., Islamabad.

Smiet, AC., G.W. Fulk and S.B. Lathiya. 1980. Rodent ecology in sugarcane in Lower Sindh, Pakistan. Acta Theriologica, 25(8): 81-97.