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Patterns of rodent pest infestation in relation to rainfed and irrigated crop systems in Rajasthan

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Abstract. A field study on the relationship between rodent fauna and crop ecosystem of the Indian Desert and its two main systems was undertaken in 5 villages and 7 dhanis near Jodhpur. Out of twelve rodent species, *Meriones hurrianae* had a highest relative abundance followed by *Tatera indica indica*, and *Rattus meltada pallidior*. Rodent fauna in the winter irrigated crops and fields was more diversified (11 species) than rainfed summer crops and fields (10 species). *M. hurrianae* was a predominant species in rainfed crop fields while, *T. indica* along with *M. hurrianae* was a codominant species in irrigated winter crops. *Rattus gleadowi* and *Vandeleuria oleracea* from summer crop fields and *Mus cervicolor phillipsi* in irrigated crop fields, were altogether absent. Relative abundance of *Funambulus pennanti, R. meltada, Mus booduga, Golunda ellioti gujerati* and *T. indica* increased from rainfed to irrigated crop systems, whereas, reverse trend was witnessed for *Rattus rattus rufescens, M. hurrianae* and two *Gerbillus* spp. (*nanus* and *gleadowi*). Occurrence patterns of different rodent species in the crop ecosystem of Indian desert as a whole, and in irrigated and rainfed crop systems in particular have been critically discussed keeping in view their ecological, physiological, behavioural and biological patterns.

Keywords. Indian desert; infestation patterns; rodent biomass.

1. Introduction

Rodents, as one of the major vertebrate pests of crops at their all growth stages, from sowing to storage through threshing, cause severe losses to overall grain production in the Rajasthan desert, the region already having dangers of crop failures and drought due to insufficient rainfall and its erratic patterns (Advani 1982). The rodent damage to several vegetable (Advani and Mathur 1982) and wheat crops (Advani 1982; Advani *et al* 1982)has been evaluated as 19.81 and 18.74% respectively.

Owing to seriousness of rodent pest problem in the crop ecosystem of Rajasthan desert, a four year (1978-1981) study was undertaken to find out rodent-crop relationship. Coinciding two rainfall periods; summer (June-August) and winter (December-February), summer (rainfed) and rabi winter (irrigated) respectively. The present paper embodies relationship between these two crop systems and species composition, relative abundance and biomass of rodents prevalent.

2. Crop habitat

Studies were undertaken in about 2000 hectare cropped area of five villages and seven dhanis (few houses encircled by cropfields and rangelands) near Jodhpur (26° 18′N, 73° 01′E), a representative desert district in Rajasthan. During June to

September among kharif (rainfed) crops, *bajra* (*Pennisetum typhoides*—a millet) is grown on about 90% of the land receiving adequate rainfall for its sowing and further growth. In addition to this some legumes and vegetables (like brinjal) are also cultivated as summer rainfed crops. In the winter rainfall period (December to February), with most of the area under wheat (*Triticum aestivum*) crop, several types of vegetables (mainly chillies, tomato, cabbage, cauliflower and other cucurbits) are harvested.

The plant and grass species in the rangelands and sandy habitat around cropfields which support rodents for food, shelter and burrowing during periods of food scarcity (April to June) are—*Prosopis cineraria, Acacia tortilis, Zizyphus nummularia, Calligonum polygonoides, Aerva tomentosa, Calotropis procera, Tephrosia purpurea, Lasiurus sindicus, Cenchrus ciliaris, C. setigerus, C. biflorus, Aristida* spp. and *Dichanthium annulatum* (Prakash 1974). The habitat is characterized by high temperatures and low and erratic rainfalls. The annual rainfall varies from 88 to 425 mm (Anon 1969), the number of rainy days being 2.7 to 28.5 per annum. The highest and lowest temperatures recorded in the past ten years are 49°C and −2°C, with annual average minimum and maximum temperatures varying from 16.4° to 22.2°C and 32.2° to 34.6°C respectively.

3. Materials and methods

Following international standard technology (Barnett and Prakash 1975), the trap indices (rodents/100 traps/24 hr), species composition, relative abundance and biomass (g/hectare) of rodents were evaluated by installing trap lines of snap (museum) traps in a grid manner in both types of crop seasons. For kharif (rainfed) crop the cropfields with bajra etc. were selected, while for rabi (rainfed) crop, traps were operated in wheat, vegetables and oilseed crop fields. Each trap line in each crop system was having 260 snap traps fixed to a wooden peg inserted deep into soil. The distance between the two traps was 10-15 m keeping in view home ranges of prevalent rodent species of Rajasthan desert.

After evaluating general infestation patterns of rodents in crop ecosystem as a whole, the sample sizes of individual rodent species were distributed between summer (rainfed) and winter (irrigated) crops to find out seasonal and cropwise species composition and relative occurrence. The trap lines were checked after every 4 hr and the dead snap trapped rodents were removed. During this checking traps were also rebaited. On the basis of morphological characteristics, rodents were identified after Ellerman (1961) and then preserved, registered and deposited in the museum of Animal Ecology and Rodent Project at Central Arid Zone Research Institute, Jodhpur.

4. Results

Twelve species of rodents were collected from the crop fields having summer (rainfed) and winter (irrigated) crops (table 1). Spread over three families and eight genera, one species (8.33%) belonged to sciurids, seven species (58.33%) belonged to murids while, four species (33.33%) represented by gerbils (79.44%) predominated over murids (18.18%) and sciurids (2.30%) groups of rodents. Among gerbils as well as all twelve rodent species, Indian desert gerbil, *Meriones hurrianae* was a predominant species, followed by another gerbil, *Tatera indica indica* and then murid, Soft-furred

Table 1. Rodent infestation patterns in the crop ecosystem of the Indian desert.

Species	N=	% relative abundance			% distribution	
		All crops	Summer crop	Winter crop	Summer crop	Winter crop
Funambulus pennanti	6	2.32	0.81	3.67	16.6	83.3
Rattus gleadowi	1	0.38	0.0	0.73	0.0	100.0
Rattus rattus rufescens	5	1.93	2.45	1.47	60.0	40.0
Rattus meltada pallidior	24	9.30	6.55	11.76	33.3	66.6
Mus cervicolor phillipsi	2	0.77	1.63	0.0	100.0	0.0
Mus booduga	4	1.55	0.81	2.20	25.0	75.0
Golunda ellioti gujerati	10	3.87	1.63	5.88	20.0	80.0
Vandeleuria oleracea	1	0.38	0.0	0.73	0.0	100.0
Meriones hurrianae	116	44.96	55.73	35.29	58.6	41.3
Tatera indica	85	32.94	28.68	36.76	41.2	58.8
Gerbillus nanus indus	2	0.77	0.81	0.73	50.0	50.0
Gerbillus gleadowi	2	0.77	0.81	0.73	50.0	50.0

Table 2. Fluctuations in rodent biomass (g/hectare) in the fields of two main crop systems of Indian desert.

Crops systems	Years (biomass g/hectare)			
	1978	1979	1980	1981
Summer (rainfed crop fields)	1836	1730	1961	1825
Winter (irrigated crop fields)	2112	1975	2324	2024

field rat, *Rattus meltada pallidior.* Occurrence of other nine species varied from moderate to very low numbers.

When total sample sizes of field rodents were segregated between two major crop systems, percent relative abundance of *M. hurrianae* was found to be highest in the summer (rainfed) crop fields. Whereas, in winter (irrigated) conditions, *M. hurrianae* and *T. indica* were observed as two co-predominant species in the rodent fauna. Relative percent occurrence of Indian palm squirrel, *Funambulus pennanti, R. meltada,* Field mouse, *Mus booduga,* Bush rat, *Golunda ellioti gujerati* and *T. indica indica* increased considerably from summer to winter crop fields. Whereas, reverse trend was witnessed in case of House rat, *Rattus rattus rufescens, M. hurrianae* and two other smaller gerbil species, *Gerbillus nanus indus* and *G. gleadowi,* though not much pronounced in case of latter two species.

Regarding percent distribution of total populations of individual rodent species trapped, *F. pennanti, R. meltada, M. booduga, G. ellioti* and *T. indica* preferred to

infest irrigated winter crops in preponderance. On the other hand, *R. rattus* and *M. hurrianae* infested rainfed crop fields and crops in higher numbers to irrigated ones. Whereas, the populations of *R. gleadowi, G. nanus* and *G. gleadowi* (all smaller species) were distributed equally between two crop systems.

In summer as well as winter crops, the rodent biomass was encountered in relatively lower magnitude in 1979 as compared to other years in the same crop systems (table 2). However, during 1980, the rodent biomass was the highest in both crops. In general with higher rodent biomass in winter crops (to summer rainfed crops), the annual fluctuations showed more or less a steady pattern in case of individual crop systems.

5. Discussion

Occurrence of a diversified rodent fauna in the crop ecosystem of the Indian desert is due to availability of diversified habitats, different crops, sandy and range land area suitable for rodents to burrow. Moreover, as the Indian desert is located at cross-roads of the Oriental, Plaearctic and Ethiopian Zoo-geographical regions from where cross-migration and establishment of different rodent species in this biome is quite expected (Prakash 1963). Moreover, all the gerbil species, which constitute about ¾th of crop rodent fauna, have all ecophysiological adaptations, particularly resistance to food and water scarcity (Advani and Prakash 1980), salt tolerance (Ghosh and Gaur 1966) and feeding adaptations (Prakash 1962). The predominant gerbil species, *Meriones hurrianae* possess all behavioural (Advani 1981a), biological (Prakash 1971) and eco-physiological adaptations for its survival, reproduction and maintenance of higher populations. The codominant gerbil species, *T. indica* also breeds throughout the year and has also higher annual productivity rate (Prakash 1971) than all other rodent species.

As the summer (rainfed) crop fields are mostly established in the rangelands and sandy plains, where *M. hurrianae* is a predominant species, it infests crop fields (mostly millet, bajra, *P. typhoides*) in relatively higher percentages. However, in the winter irrigated crop fields with wheat, chilli and most of the vegetable crops, it co-shares predominance with *T. indica* which is a major pest of wheat (Advani *et al* 1982) and vegetables (Advani and Mathur 1982). In the irrigated crop fields, *T. indica* as well as *R. meltada pallidior* which require some moist soil or surrounding mud walls around the crop fields to burrow, justify their existence in winter crop in more numbers. *R. meltada* population can also depend upon stored wheat in hutments in absence of crop in field (Rana and Advani 1981). *G. ellioti*, a pest of wheat threshing floors (Advani 1981 b,c) is also likewise collected in moderate abundance in irrigated over-rainfed crops. Dependance of squirrel over fruits, vegetables etc., for food and surrounding large neem, banyan (*ficus*) and fruit trees for nesting (Banerji 1955), regulate their occurrence in crop fields under irrigation in winter season. Relative occurrence of higher rodent biomass during the year 1980 in both crop ecosystems, is probably due to average good rainfall during that year which had an ultimate impact on better crop production, essential to support higher rodent biomass.

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