Environment and Ecology 36 (2) : 381—386, April—June 2018
Website: environmentandecology.com ISSN 0970-0420

Burrow Structure of Rodents in Different Crop Fields of Punjab

Navdeep Kaur, Neena Singla

Received 1 June 2017; Accepted 2 July 2017; Published on 21 August 2017

Abstract The structure of eleven burrows of three different species of rodents i.e. the Indian gerbil, *Tatera indica*, the soft furred field rat, *Millardia meltada* and the lesser bandicoot rat, *Bandicota bengalensis* was studied in rice, wheat and pea crop fields of Punjab during the years 2013 to 2015. There was found variation in different burrow parameters such as the number of burrow openings, diameter of the openings, depth of burrow, total number of tunnels, total length of the tunnels, number of dead ends, turns and brood and food chambers among different rodent species as well as burrows of same species. However, in all the three species, the hoarded material found in the brood and food chambers greatly depended on the kind of surrounding crop and the nests were found at certain depths in the ground.

Keywords Burrows, Crop fields, Punjab, Rodents.

Navdeep Kaur*, Neena Singla
Department of Zoology,
Punjab Agricultural University,
Ludhiana 141004, India
e-mail : navdeepkaur@pau.edu
*Correspondence

Introduction

Rodents occur in virtually every terrestrial environment that supports life (wild, agricultural or urban). Rodents caused 6–8% loss in rice, 10–12% in wheat and 5.8 to 32.76% in sugarcane crops in India [1—3]. Most rodents are inhabitants of burrows. The subterranean mode of living provides the rodents home, protection from predators and extreme temperature. Studies on the burrowing habit of rodent pests are required to understand their social organization and behavior. Further, burrows also help to distinguish rodents from other burrowing animals, for population estimation, placing poison baits and physical control. Burrow is the fort of a rat and the rat uses its best abilities to construct it for its peaceful living and protection against its enemies. Effective rodent control strategies cannot be developed without having sufficient knowledge of rat bioecology [4]. The species of rats and mice inhabiting crop fields in Punjab are the lesser bandicoot rat, *Bandicota bengalensis*, the soft furred field rat, *Millardia meltada*; Indian bush rat, *Golunda ellioti*; Indian gerbil, *Tatera indica*; short tailed mole rat, *Nesokia indica*; house mouse and field mouse, *Mus musculus* and *Mus booduga*. The

Table 1. Features of burrow structure of different rodent species. Ti *Tatera indica*, Mm *Millardia meltada* and Bb *Bandicota bengalensis*, n = No. of burrows examined, Values are expressed as mean ± SE, Figures in parentheses represents the range.

Parameters	Ti (n=4)	Mm (n=3)	Bb (n=4)
No. of openings	1.50 ± 0.29 (1–2)	1.67 ± 0.67 (1–3)	1.00 ± ± 0.00 (1–1)
Diameter of opening (cm)	7.00 ± 0.63 (4–8)	7.20 ± 0.34 (6.5–8)	5.38 ± 0.90 (4–8)
Depth (cm)	46.75±9.62 (22–63)	51.00±10.00 (31–61)	24.75±2.25 (19–30)
Total no. of tunnels	1.50 ± 0.29 (1–2)	1.67 ± 0.67 (1–3)	1.00 ± 0.0 (1–1)
Total length of tunnels (cm)	99.25±16.22 (57–136)	224.0±54.05 (122–306)	112.25±31.14 (41–165)
No. of dead ends	0.50 ± 0.29 (0–1)	0.33 ± 0.33 (0–1)	1.25 ± 0.75 (0–3)
No. of turns	1.25 ± 0.48 (0–2)	2.67 ± 0.88 (1–4)	3.25 ± 1.80 (0–8)
Total no. of chambers	0.25 ± 0.25 (0–1)	1.67 ± 0.67 (1–3)	1.50 ± 0.29 (1–2)
No. of brood chamber	0.25 ± 0.25 (0–1)	1.00 ± 0.0 (1–1)	1.00 ± 0.58 (0–2)
No. of food chamber	0	0.33 ± 0.33 (0–2)	0.50 ± 0.29 (0–1)

nature and internal structure of burrows of field rodents have been reported for *B. bengalensis, M. booduga, M. meltada* and *T. indica* in different parts of India. However, information available so far in Punjab state is limited. Therefore, the present study was undertaken to examine the different characteristics of rodent burrows in different cropfields of Punjab so that potential management practices can be opted to reduce the damage caused by these rodent pests.

(Authors wish to thank Indian Council of Agricultural Research, New Delhi, India for the financial support and Department of Zoology, Punjab Agricultural University, Ludhiana, India for providing necessary facilities for undertaking research work).

Materials and Methods

Study area and duration

This study was conducted in different crop fields in three districts (Ludhiana, Moga and Fategarh Sahib) of Punjab during the years 2013 to 2015.

Location

A total of 11 burrows (numbered as 1 to 11) were excavated and various particulars such as location, district, cropland and month of study are recorded. The burrows of different species were identified based on their characteristic burrow entrances as noticed in one earlier study also [2].

Burrow pattern

The identified burrows were studied visually for their structure. The diameter of the entrance was recorded. Thereafter, with the help of a spade those burrows were dug out from the burrow entrances which evidenced most recent excavation by rats. The parameters such as number of burrow openings, diameter of the openings, depth of burrow, total number of tunnels, total length of the tunnels, number of dead ends, turns, and brood and food chambers and the type of nesting material in brood chambers as well as hoarding material in food chambers were recorded. All measurements were taken using a calibrated measuring tape. The distance of nesting chamber from the surface was also recorded. Moreover, trapping was also carried out from near the burrows and species captured were recorded.

Statistical analysis

All the parameters studied for different burrows were interpreted as mean ± SE for each rodent species.

Results and Discussion

The rodents build complex burrow systems with a number of burrow openings, numerous nest chambers and associated interconnecting tunnels. The burrow parameters varied from species to species, within members of same species and also with the situation to meet specific requirements. Therefore,

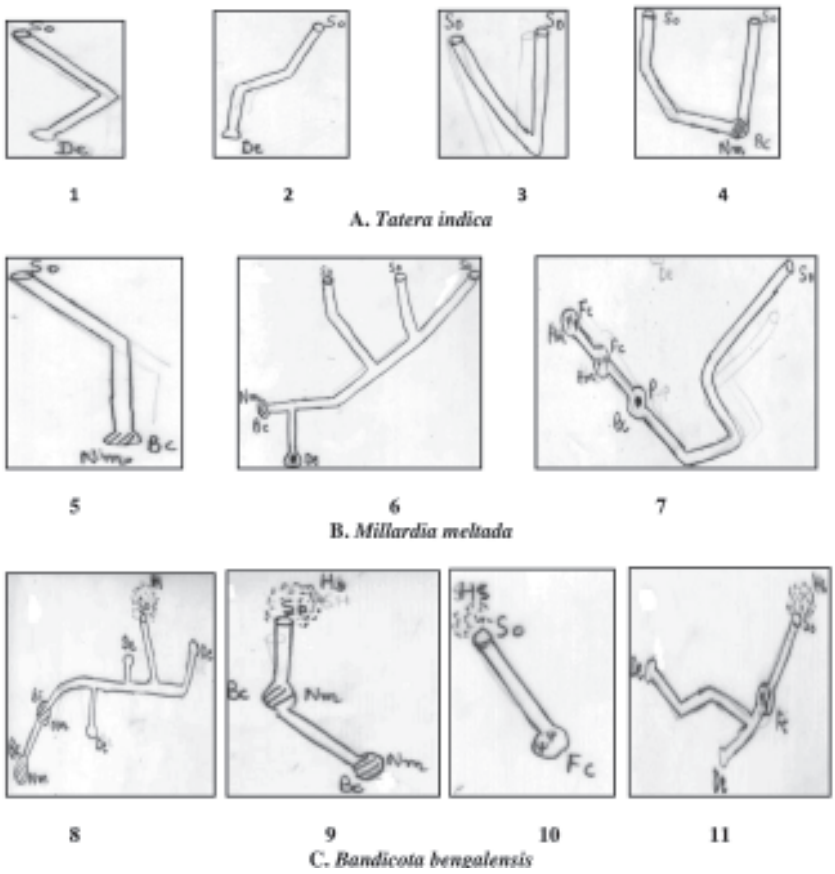

Fig. 1. Burrow structure of different rodent species. So–Surface opening, Bc–Brood chamber, Nm–Nesting material, Fc–Food chamber, Hm–Hoarding material, P–Pup, De–Dead end, Hs–Heap of soil.

structure of all the eleven rodent burrows dug out has been discussed.

Tatera indica

The four burrows (Burrow no. 1, 2, 3 and 4) (Fig. 1 A) of *T. indica* were dug out at Ladhowal Seed Farm of Punjab Agricultural University (PAU), village Ladhowal, district Ludhiana and village Lohara, district Moga in harvested rice crop fields and wheat crop fields, respectively. The average of all parameters revealed that burrows of *T. indica* have 1.50±0.29 openings with average diameter of 7.00±0.63 cm and depth of 46.75 ±9.62 cm, 1.50 ± 0.29 number of tunnels having total tunnel length 99. 25 ± 16.22 cm, 0.50 ± 0.29 no. of dead ends, 1.25 ± 0.48 no. of turns, 0.25 ± 0.25 as no. of total brood chambers (Table 1). The range of different parameters indicated that burrows of *T. indica* have 1–2 openings having diameter 4–8 cm and depth 22–63 cm, 1–2 no. of tunnels with total length 57–136 cm long, 0–1 dead ends, 0–2 no. of turns, 0–1 no. of brood chambers. Out of the four burrows of *T. indica* studied, burrow no. 3 and 4 formed characteristic V shape. No food chamber was

Table 2. Different parameters observed in internal structure of different rodent burrows. Ti *Tatera indica*, Mm *Millardia meltada*, Ni *Nesokia indica* and Bb *Bandicota bengalensis* *Rodent trapped near burrow opening.

Burrow no.	Rodent species	No. of openings	Diameter of opening (cm)	Depth (cm)	Total no. of tunnels	Total length of tunnels (cm)	No. of dead ends	No. of turns	Total no. of chambers	No. of brood chamber/nesting material/distance from surface	No. of food chamber/ hoarding material
1	*Ti	1	4	22	1	57	1	1	–	–	–
2	*Ti	1	8	63	1	100	1	2	–	–	–
3	Ti	2	8, 8	41	2	104	–	–	–	–	–
4	Ti	2	7, 7	61	2	136	–	2	1	One with rice straw and rice panicles at depth of 61 cm	–
5	Mm	1	6.5	61	1	122	–	1	1	One with a nest of green grass available at a depth of 61 cm	–
6	Mm	3	7, 6.5, 8	61	3	244	1 with a pup	4	1	One with nest of rice straw at a depth of 46 cm	–
7	Mm	1	8	31	1	306	–	3	3	One with green grass and a pup at depth of 18 cm	Two with pea pods
8	Bb	1	5	30	1	165	3	8	2	Two with rice straw at depth of 10 cm and 25 cm	–
9	Bb	1	4.5	19	1	41	–	1	2	Two, one with rice grains and rice straw at a depth of 6 cm and second with rice straw at a depth of 19 cm	–
10	Bb	1	4	25	1	79	–	`–	1	–	One with pea pods
11	Bb	1	8	25	1	164	2	4	1	–	One with pea pods

observed in the burrows of *T. indica* in the present study (Table 2). This species is well adapted behaviorally and physiologically to desertic conditions and hence can meet its daily needs of food from the fluctuating food resources of the desert. Earlier, the study on burrow system of *T. indica* revealed it to be a simple Y shaped type with one or two surface openings and with a seasonal shift towards maximum burrow depth, i.e. from 35 cm in winter to 45–50 cm in summer and lack of habit of food storage in burrows.

Millardia meltada

The three burrows (Burrow no. 5, 6 and 7) (Fig. 1B) of *M. meltada* were dug out at village Lohara, district Moga and Naraingarh Seed Farm of PAU, village Naraingarh, district Fatehgarh Sahib in the harvested wheat and pea crop fields, respectively. The average of different burrow parameters indicated that this species constructs burrows having maximum number of openings (1.67 ± 0.67), having diameter of 7.20 ± 0.34 cm and pepth of 51.00 ± 10.00 cm, 1.67 ± 0.67 no. of tunnels with total length of 224.0 ± 54.05 cm, 1.67 ± 0.67 no.of chambers and 1.00 ± 0.00 no. of brood chambers (Table 1). Moreover, an average of 0.33 ± 0.33 no. of dead ends as well as no. of food chambers and 2.67 ± 0.88 no. of turns were also observed from the different burrows of *M. meltada*. The range of different burrow parameters indicated that the burrow of this species have 1–3 openings having diameter of 6.5–8 cm and depth, 31–61 cm, 1–3 number of tunnels having total length of 122–306 cm, 0–1 dead end, 1–4 number of turns, single brood chamber and 0–2 no. of food chamber. All the three burrows studied showed the presence of brood chamber containing nest made of rice straw or green grass material and

located at a depth of 18, 61 cm (Table 2). One of the burrow i.e. burrow no. 7 dug out in harvested pea crop fields indicated the presence of single pup in the brood chamber and this burrow also showed presence of two food chambers containing pea pods. On the other hand, burrow no. 6 showed the presence of single pup in dead end. However, earlier studies on ten burrows of *M. meltada* reported an average length 106.2 cm, depth 38.1 cm, diameter of burrow openings 3.6 cm, brood chambers 1.13, food chambers 1.13, surface openings 2.73 in number and hoarded food material 50.12 g [5]. In the present studies, it was also recorded that in summers burrows are deeper than in winters as burrow no. 5 and 6 dug out in the month of November coinciding the completion of summer season was more deeper as compared to burrow no. 7 dug out in the month of March i.e. end of winter season in Punjab.

Bandicota bengalensis

Four burrows (Burrow no. 8, 9, 10 and 11) (Fig. 1C) of *B. bengalensis* were dug out at Ladhowal Seed Farm of PAU, village Ladhowal, district Ludhiana and Nariangarh Seed Farm of PAU, village Naraingarh, district Fatehgarh Sahib in the harvested crop fields of rice and pea, respectively. The average of different burrow parameters studied revealed that *B. bengalensis* have maximum number of dead ends 1.25 ± 0.75, number of turns 3.25 ± 1.80, number of brood chambers 1.00 ± 0.58 and number of food chamber 0.50 ± 0.29 among all the species. Moreover, this species showed an average of 1.00 ± 0.00 number of openings, having diameter of 5.38 ± 0.90 cm and depth, 24.75 ± 2.25 cm, 1.00 ± 0.00 total no. of tunnels having 112.25 ± 31.14 cm total length and 1.00 ± 0.58 number of brood chambers and 0.50 ± 0.29 number of food chambers (Table 1). The range of different parameters indicated that burrows of *B. bengalensis* have one opening of diameter 4–8 cm and depth 19–30 cm. Single tunnel with total langth of 41–165 cm, 0–3 dead ends, 0–8 number of turns, 0–2 number of brood chambers and 0–1 number of food chambers (Table 1). Out of the four burrows studied, two burrows (no. 8, 9) revealed the presence of two nests in each burrow which were situated at a depth of 6 cm to 25 cm and the nest contained rice straw and rice grains since these burrows were dug out in harvested rice crop fields (Table 2). However, no separate hoarding chamber was located in these two burrows. On the other hand, two burrows (no. 10, 11) showed the presence of one food chamber with pea pods since these burrows were dug out in harvested pea crop field. The present findings are in accordance with earlier studies [1] which reported *B. bengalensis* produce some simple burrows which consists of unbranched tunnels with resting, nesting and hoarding chambers. However, some studies reported that burrows of *B. bengalensis* are elaborate with interconnected tunnels, galleries having multiple openings, with a nest chamber and more than one food-storage chambers. One of the earlier study also found that [6] an average of 0.478 ± 57.9 kg food material was found hoarded per burrow of *B. bengalensis* in wheat crop fields.

The literature also reported that burrow systems vary greatly among different rodent species and even within a species, depending on the soil type; compaction, porosity and depth, water table levels; aspect and slope; vegetation type and density; latitude, [6] as well as with the age of occupying animal, type and growth stage of the crop [6]. Moreover, the more number of burrow entrances of kangaroo rat in summers as compared to winters helping in thermoregulatory savings for occupants [7]. The study on burrowing pattern of rodent pests also reported that the burrow pattern varies with the structure of soil and with type of crop, the nest chamber was found situated far from the nearest opening in order to avoid disturbance to the litters in the nest and storage of material in the hoarding chamber was related to the crops surrounding the burrows [1]. The burrow systems are also presumably used for sleeping at night, napping during the day, parturition and litter rearing, group nesting (social thermoregulation) and avoiding inclement weather [8].

Thus, the present studies showed that there is variation in burrow structure among different species as well as the members of same species. The number of surface openings and number of tunnels inside the burrow were found to be same as tunnel arises from each of the surface opening in case of all rodent species studied. The material found in the brood chamber and food chamber greatly depended on the surrounding crop and the nests of all rodent species

were found to be present at certain depth from the ground. Therefore, an idea of burrow structure of different rodent species as obtained in the present studies by studying different parameters can help us to successfully bring the rodent control operations such as burrow baiting for effective control of rodent species as these control strategies can not be developed without having sufficient knowledge of rat bioecology and thus preventing their damage to different crops.

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