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Observations on the social behaviour of the Indian desert gerbil, *Meriones hurrianae*

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Abstract. Socio-behavioural components (fighting, chasing, scent marking, thumping, digging and kick back) were studied in a group of Indian desert gerbil, *Meriones hurrianae* in a Rattery (13 × 7 m). Male gerbils were found to be more active and performed all the aggressive acts at a higher frequency ($P < 0{\cdot}01$) than the females, indicating that social organization in *M. hurrianae* is male-dominated. It was revealed that this gerbil is not contact-prone in nature and the associates in a social group avoid the dominant ones. The dominant male accepts subdominant individuals, whereas only the dominant female performs aggressive acts. The evolution of sociability in *M. hurrianae* has an adaptive value of self-regulatory mechanism of population control.

Keywords. *Meriones* ; social behaviour ; scent marking ; thumping ; gerbil ; aggression.

1. Introduction

The desert gerbils, *Meriones hurrianae*, the predominant mammalian species found in the Indian desert, are gregarious by habit, their home ranges overlap and they defend only one or two 'most-used' burrow openings (Fitzwater and Prakash 1969). Locked-fights are seldom witnessed in nature, the chased ones duck in the burrows, usually avoiding encounters. Their burrows are extensive, interconnected in fairly large areas (Prakash 1980) but the male and female stay separately except during the littering period when the mother stays with the litter till their weaning (Prakash 1962). With this field knowledge, we studied their social organization in a large rattery under simulated conditions and the results are presented here.

2. Material and methods

The Indian desert gerbil, *Meriones hurrianae* (Jerdon) were live-trapped from the sandy plains at Jodhpur (26° 18′ N–73° 01′ E) and were maintained for a few days in the laboratory, were weighed, sexed, and dyed on different parts of the body

for identification. Three males and 6 females were released in the rattery at the same time and were allowed to 'dig in' for 15 days. Thereafter, observations were made with the help of field binocular for 15 days, one hour daily during February, from 11 to 12 noon, their maximum activity epoch during this season. All the above ground activities were observed and their movements were also recorded on a graph paper corresponding to the quadrats delineated in the rattery. Two food stations and two water points were established at the centre of the rattery. The number of trips to the food and water platform, the number of entries and exits from the burrow openings, activities like digging, kick back, thumping, scent-marking, chasing, and fighting were observed to reconstruct the social order among the merion gerbils.

The oval rattery (13 × 7 m) is constructed in an open rangeland at the farm of this Research Institute. It is enclosed by 3·5 m high walls and roofed by wire mesh to prevent any predators. It is divided by numbered pegs in a 1·5 m^2 checkerboard design to facilitate the location of rodents for the study of their movements. Two built-in-chairs are provided for the observers in the walls at a height of 1 m.

3. Observations

3.1. *Activity*

During the study period the male *M. hurrianae* were observed to be more active ($P < 0·01$) than females both with respect to total number of emergence from the burrow openings and the number of opening used (table 1). Among the males, the heaviest, no. 1 (101 g) made significantly ($x^2_{(1)} = 22·14$, $P < 0·001$) more visits (52·6%) and used the largest number of burrow openings, followed by no. 8 which was lighter (64·5 g) in body weight as compared to no. 4 (88·5 g). Among the six females, no. 2 (body weight 57 g, table 2) was most active (48·7% of the total visits made by all females) followed by no. 6 (69 g, 22·3% of the visits). The

Table 1. Differential performance of behavioural acts by male and female *M. hurrianae*.

Sex	Mean numbers ± S.E.						
	Body weight	Visits from burrow opening	Visits to feeding platform	Visits to drinking platform	Thumping	Digging and kick back	Ventral scent marking
Male	84·66 ±10·71	133·33** ±32·30	64·66** ±21·59	8·33^{NS} ±2·90	18·00** ±7·37	50·33** ±21·06	15·66** ±7·76
Female	59·58 ±3·77	54·16 ±1·68	14·83 ±4·15	5·50 ±3·73	1·16 ±0·30	12·66 ±2·96	0·50 ±0·25

Level of significance : ** = $P < 0·01$, NS = Not significant (Students' t test, Bailey 1959).

number of visits by the former female were by far more ($x^2_{(1)} = 28{\cdot}30$, $P < 0{\cdot}001$) than any other female whereas such a gap was not observed among males. Though there was no relationship between body weight and number of visits, some association is observed between the area of movements and dominance of rodents, the dominant one exploring maximum space. Nevertheless none of the gerbils occupied exclusive range of movement and almost all ranges overlapped each other (figures 1 and 2). However, an interesting possessive behaviour was shown by all the three males, their ranges surrounded the food and water platforms (figure 1). Such was not the case with females as only the range of the dominant no. 2 and the next, no. 6 extended to cover the food and water source (figure 2). This difference in the behaviour of the two sexes is also confirmed by the relative number of visits by them to the feeding and drinking platforms (table 2) from which it is clear that the females, other than 2 and 6, do visit the feeding and drinking platform but not at the time when relatively more dominants are active—exhibiting avoidance behaviour and also suggesting that *M. hurrianae* is not a contact-prone animal. As a result most of the interactions observed were between the three males and females nos. 2 and 6.

3.2. *Fighting, chasing and following*

As defined by Eibl-Eibesfeldt (1951) and Eisenberg (1963) a total number of 67 social interactions were observed (table 3), of which 40 were males, indicating that the number of female *M. hurrianae* is significantly less ($X^2_{(1)} = 45{\cdot}71$, $P < 0{\cdot}001$) involved in them. Among both the sexes acts of fighting were significantly less than those of chasing ($X^2_{(1)} = 18{\cdot}96$, $P < 0{\cdot}001$). Out of the three males, only two and out of six females only three participated in social interactions. The frequency of performance of these acts was largely restricted to gerbil no. 1 among males (88·7% of total) and no. 2 among females (88·9%).

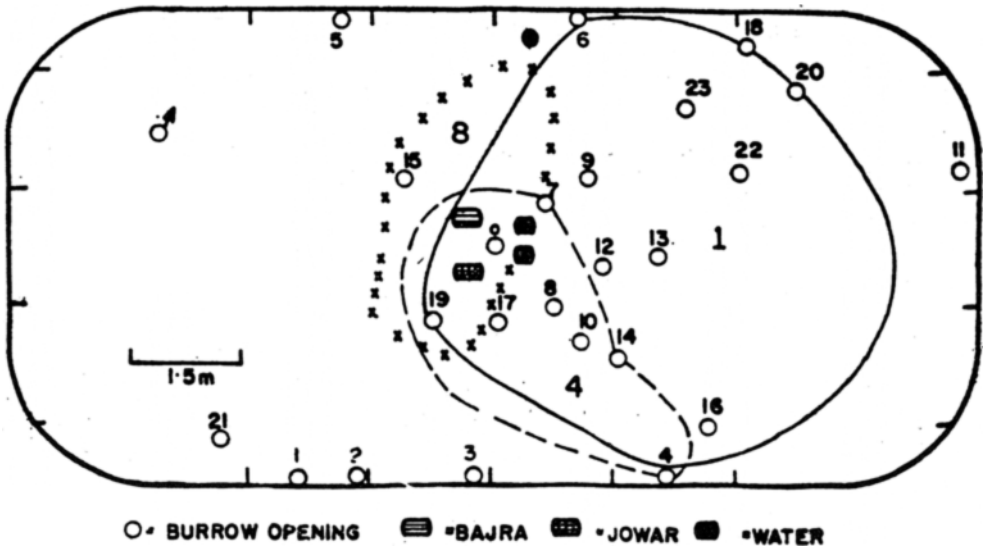

Figure 1. Range of movement of male gerbils in the rattery.

Table 2. Total number and mean (± SE.) of behavioural components of *M. hurrianae*.

Mark number of animal	Sex	Body weight (g)	Visits from burrow opening	Number of acts per gerbil per hour			Digging and kick back	Ventral scent marking
				Visits to feeding platform	Visits to drinking platform	Thumping		
1.	Male	101	14·33±1·99 (215)*	4·40±1·21 (66)	0·46±0·24 (7)	2·26±1·36 (34)	4·20±1·83 (63)	2·73±1·57 (41)
4.	Male	88·5	3·26±0·99 (65)	0·20±0·00 (3)	0·20±0·15 (3)	0·33±0·20 (5)	..	0·20±0·00 (3)
8.	Male	64·5	8·26±2·17 (124)	7·60±3·62 (114)	1·00±0·70 (15)	1·00±0·55 (15)	5·86±3·40 (88)	0·13±0·00 (2)
2.	Female	57	10·00±1·50 (150)	2·94±0·84 (38)	1·53±0·37 (23)	0·46±0·28 (7)	5·06±1·74 (76)	0·20±0·15 (3)
3.	Female	69	1·13±0·68 (17)	(1)	..	..	..	..
5.	Female	50	3·26±0·99 (49)	0·26±0·00 (4)	..	..	..	..
6.	Female	69	6·46±2·26 (97)	1·93±0·97 (29)	0·53±0·38 (8)	..	..	..
7.	Female	61·5	0·73±0·45 (11)	1·13±0·64 (17)	0·13±0·09 (2)	..	..	..
9.	Female	51	0·33±0·25 (5)	..	..	..	..	..

* Total number of acts.

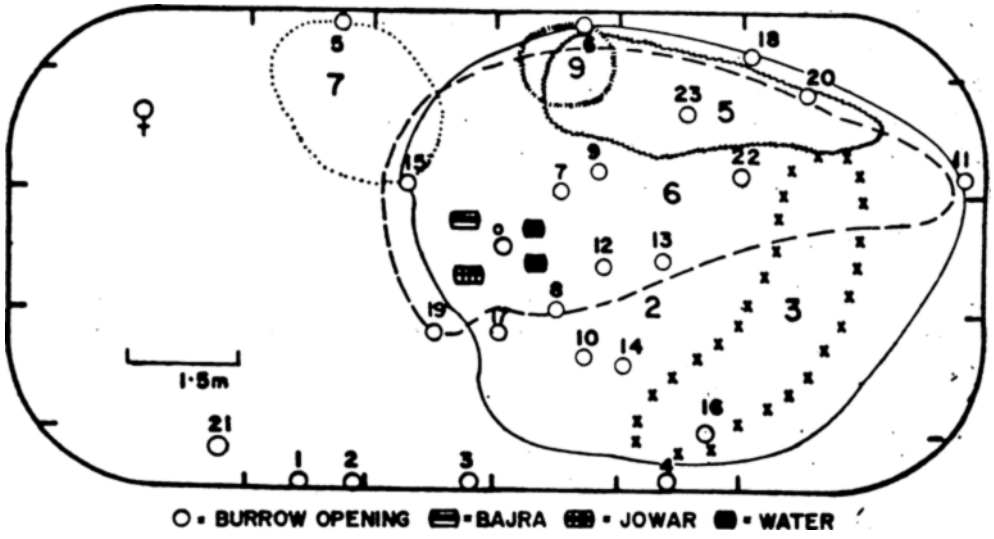

Figure 2. Range of movement of female gerbils in the rattery.

Table 3. Number of social interaction acts.

Sex	Mark number of animal	Fighting	Chasing	Following	Total
Male	1	5	25	5	35
Male	8	2	3	—	5
Female	2	4	14	6	24
Female	6	—	1	—	1
Female	7	—	—	2	2
Total		11	43	13	67

The dominant animals were identifiable by the observer because of the number of times others stayed away from them, and on the basis of their chasing activity. It, therefore, appears that chasing a component of aggressive behaviour is more frequent in *M. hurrianae* than fighting.

3.3. *Scent marking*

Scent marking with the mid-ventral gland (Kumari *et al* 1981) was observed near the burrow openings and on heaps of soil near them. This behaviour was usually followed by acts of digging with fore paws and kicking the soil back by the hind paws. All the three males performed marking. However, it was carried out by the gerbil no. 1, 41 times out of 46 acts. A similar response is shown by other gerbil species, *Meriones tristami* (Thiessen *et al* 1973) *M. unguiculatus* (Thiessen

and Yahr 1977), *M. libycus* and *M. crassus* (Daly 1977). Among the females, only the gerbil no. 2 scent marked and none of the other females indulged in this activity. Almost a similar trend of the digging and kick-back behaviour in the two sexes of *M. hurrianae* was observed (table 2). Such a behaviour component performed exclusively by the dominant ♀ *M. hurrianae* in a social group has not been reported in other species of *Meriones*.

3.4. *Thumping*

Thumping or drumming by the hind foot, a behaviour exhibited as an alarm signal to the colony (Fitzwater and Prakash 1969), territorial claim (Fiedler 1973), an unspecified role in mating (Eibl-Eibesfeldt 1951) or reaction of displacement activity (Eisenberg 1967; Routtenberg and Kramis 1967) were observed to be performed by all the males, the frequency being the highest by male no. 1. But only one female (no. 2) did it. Between these two individuals the frequency of thumping by the female was significantly low ($x^2_{(1)} = 32{\cdot}80$, $P < 0{\cdot}001$). On an overall basis also, thumping frequency by males is significantly higher ($P < 0{\cdot}01$) than by the females (table 1). Interestingly male no. 4, lowest in the dominance hierarchy in the group of gerbils thumped steadily for 68 minutes near the burrow opening number 10. This thumping sequence was much longer than that of the sand rat, *Psammomys obesus* which thumped at a time for 23 minutes (Daly and Daly 1975).

4. Discussion

It is evident from the observations made on the free-living colony of *Meriones hurrianae* in the rattery that the Indian desert gerbil, though gregarious, lives a solitary life. Their ranges of movements overlap and they socially interact, males being more aggressive than the females. It is also observed that in one group of animals the dominant male *M. hurrianae* tolerates other sub-dominant males but among females, dominance is restricted to only one animal. This hypothesis can be clearly visualised through the data in table 2 and figures 1 and 2. All the males scent mark, dig and kick back and foot-thump but only the dominant female no. 2 performs these acts, none of the other females, despite the fact that nos. 3, 6 and 7 are heavier than no. 2, participate in these activities. Among males, these acts are performed at a maximum frequency by no. 1 and by 8 and 4 in descending order (table 2). Their range of movements also exhibit a similar pattern, the largest being that of no. 1, than those of nos. 8 and 4 (figure 1). Likewise female no. 2 possesses the largest range of movement (figure 2). It is confirmed from these observations that the dominant male tolerates other sexually potent males in the social group but the dominant female does not allow other females to perform any of the aggressive activities. Thus the magnitude of dominance is more severe in females. Among the two dominants, male no. 1 and female no. 2, the former is more aggressive as evidenced by the social interactions (fighting and chasing). The lower ones in the social order avoided the former and adjusted their activity pattern for the purpose.

It is visualised that the evolution of sociability in *M. hurrianae* as observed and presented above in the desert environment may have an adaptive value of self-

regulatory mechanisms (Wynne Edwards 1962; Eisenberg 1967), whereas populations are kept below maximum numbers by restricting mating to only a few males and the dominant female not allowing through social interactions the dominant male to mate with other females of the group. This contention is further supported by the observation that only the dominant female scent marks (table 2) the given area through which it possibly familiarises the male with its own odour thus obliterating other females of the group from the chance of mating, besides restricting their movements by its aggressive behaviour as observed in the rattery (table 1, figure 2). The frequency of scent marking by female increases significantly ($P < 0{\cdot}01$) during oestrus (Kumari and Prakash 1981) for the purpose. The exchange of this chemical signal thus plays an important role in reproduction and social organisation. As a result the prevalence of pregnancy in the free-living natural population of *M. hurrianae* which is more abundant remains at a "low" all through the year as compared to that of the commensal gerbil, *Tatera indica indica*, both inhabiting the same ecological niche in the desert (table 4).

A number of views have been advanced by various workers regarding the behavioural adjustments within a species for self-regulatory mechanism of poputation control. Chitty (1960) suggested a genotypic hypothesis but as far as is known relevant evidence to corroborate this theory has not yet been obtained. Christian and Davis (1964) support a phenotypic hypothesis of self-regulation by a behavioural endocrine feedback system, elicited by "social pressure" and operating through the pituitary-adrenocortical axis. Krebs (1966) did not, however, obtain direct evidence of phenotypic or genotypic changes in his demographic study

Table 4. A comparison of prevalence of pregnancy in *M. hurrianae* and *Tatera indica indica.*

	Prevalence of pregnancy (%) Species	
	M. hurrianae	*Tatera indica indica*
January	7·6	26·6
February	24·2	47·4
March	20·8	30·0
April	20·0	12·5
May	12·0	16·6
June	11·4	41·1
July	21·0	46·6
August	16·6	61·0
September	18·2	9·7
October	26·6	10·5
November	20·0	38·8
December	9·3	15·7
Annual source	17·0	29·0
	Kaul and Ramaswami (1969)	Jain (1970)

on the fluctuating populations of California vole, *Microtus californicus*. Our observations on the desert gerbil, *Meriones hurrianae* support the Wynne-Edwardsian (1962) hypothesis of self-regulation of population.

Eisenberg (1967) categorised the social organisation of rodents into three major categories: solitary, pair tolerant, and commensal. Our observations point out that *M. hurrianae* falls in between solitary and pair tolerant species in its natural environment.

The social organisation of *M. hurrianae*, it appears, is not contact prone in nature and is based on avoidance of the dominant ones by other associates in the group. It also revealed that *M. hurrianae* group is socially male-dominated, unlike *M. libycus* where the female is at the top of social order (Agren 1979).

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