

Influence of Odours of Indian Gerbil, *Tatera indica* on the Social and Scent-marking Behaviour of Sympatric Desert Gerbil *Meriones hurrianae*

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After recording the frequency of various social and scent marking activities of every individual in a resident population of the diurnal desert gerbil, *Meriones hurrianae* an equal (6 male, 6 female) group of more aggressive, nocturnal, sympatric Indian gerbils, *Tatera indica* was introduced in a battery (13 × 7 m). The observations clearly indicate that the scent marks of sebum exudation of the mid ventral marking gland and urine of the nocturnal *Tatera indica* are perceived by the diurnal *Meriones hurrianae*. The latter responds to odours of the intruder, *T. indica* by significantly shrinking its home ranges and by significantly enhancing its sebum-scent marking activity in a way to saturate the general area with its own odours. These observations also point out that the olfactory cues of one species signal messages to other sympatric species and the latter responds to them in a way to establish its own dominance on the former. However, a 'matching of odours' competition sets in between the resident and intruder species in the common space of resource utilisation by superimposing their own odours on that of others.

Key Words: Aggressive behaviour, Desert gerbil, Home range, Indian gerbil, *Meriones hurrianae*, Olfactory communication, Scent marking, Social interaction, *Tatera indica*

Introduction

The two sympatric gerbils, *Tatera indica* and *Meriones hurrianae* constitute 41.6% and 19.0% of the rodents found in the sandy biome of the Indian desert (Prakash 1975). The former is nocturnal and the latter diurnal. However, the diel activity rhythm of *M. hurrianae* is bimodal during the summer months, with an early morning peak and a

late afternoon peak (Prakash 1962). Aggressive interactions between the two species are never seen in nature in spite of the fact that their burrows are located side by side in the sandy habitat and their foraging grounds are the same.

A ventral scent marking gland is present in both sexes of the two species, but the

frequency of its occurrence varies significantly among female *T. indica* living in two distinct habitats, according to two different types of social organisation. Whereas 42.29% of the solitary females from sandy scrub exhibit the gland, only 3.2% of the females living gregariously in the urban environment possess it (Prakash & Kumari 1979, Idris & Prakash 1982). They scent mark in their home ranges with the sebum of the scent marking gland and urine (Idris & Prakash 1982). The major objective of the present study was to investigate the influence, if any, of the odours of the more aggressive, nocturnal Indian gerbil, *T. indica*, on the behaviour and scent marking of the diurnal desert gerbil, *M. hurrianae* under semi-natural conditions in a rattery.

Material and Methods

Desert gerbils, *Meriones hurrianae* and Indian gerbils, *Tatera indica* were live trapped in the sandy habitat around Jodhpur (16°18'N-73°01'E). Six adult male and six female desert gerbils (avg. body wt. of males: 86.83 g ± 4.48; and of females: 76.66 g ± 5.32) were released in the rattery (13 × 7 m) and acclimatized for 6 days. They were marked by toe as well as hair clipping. Observations were then made for 20 days on their social behaviour in relation to scent marking for 1 hr/day at the time of their maximum activity (10 to 11 AM) during winter. Thereafter, equal numbers of *T. indica* (avg. body wt. of 6 males: 118.66 g ± 7.88 and of 6 females: 153.33 g ± 14.59) were released in the same rattery. Behavioural observations on both the species continued for 20 days. *T. indica* were observed every evening under dim red light for one hour. Once a week, behavioural acts were recorded for a continuous 24 hours period. Food and drinking water were provided *ad libitum* at three feeding platforms (figures 1-4).

Results

On release in the rattery, the desert gerbils explored the whole area whereafter swift

digging activity started. Twenty-eight burrow openings were dug during the first week and their number increased to 42 by the end of 40 days. The desert gerbils were never observed venturing out of the burrows after dusk. Scent marking activity with the sebum of the ventral scent marking gland and with urine (perineal drag) was observed in both sexes (table 1). The sebum marking was found to be more frequent in males and urine marking in females. Both types of marking were observed on stones or on protruding soil lump near the burrow openings and in the surrounding area. Thumping with the hind foot was also performed by both sexes. The number of fights and chases initiated by male desert gerbils was more than that by females (table 3). The average range of movement of males in the rattery was 39.06 m² ± 6.47 and that of females 40.45 m² ± 9.47 (figures 1 & 2). Almost all home ranges overlapped each other (figures 1 & 2) as was observed earlier in their natural habitat (Fitzwater & Prakash 1969).

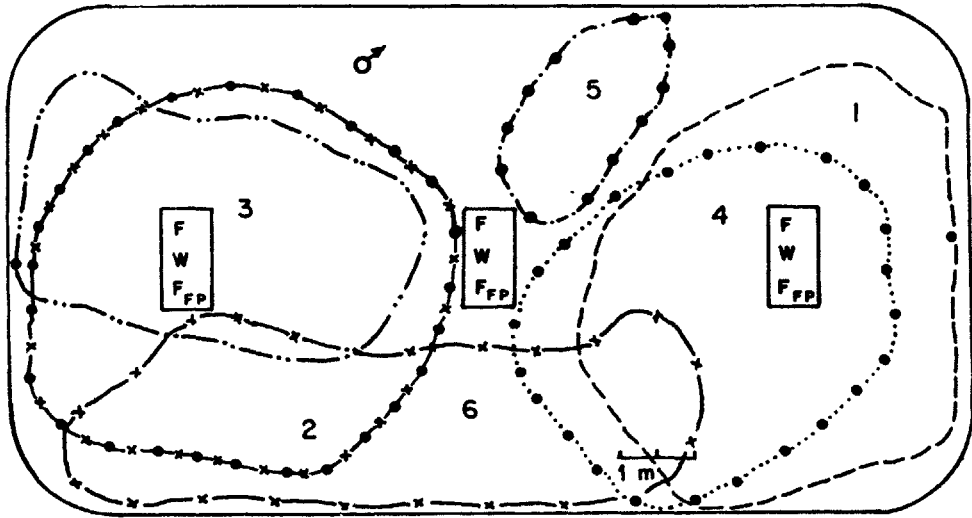
On their release in the rattery inhabited by 6 male and 6 female *M. hurrianae*, the 12 Indian gerbils, *T. indica* surveyed the entire area and entered the burrows of other species. This created a sort of commotion in the residential population of desert gerbils which ventured out of the burrows even though it was dusk, which is ordinarily not a period for their out-of-the-burrow activity. As a consequence, interspecific interactions were observed and in a majority of cases it was the Indian gerbil which initiated the interaction and the desert gerbils were chased into the burrows. When a desert gerbil entered the burrow opening after being chased by an Indian gerbil, the latter stopped outside the burrow opening, wagged its tail vigorously and scent marked the burrow opening with the sebum of its ventral gland. The Indian gerbil also scent and urine marked the points carrying the sebum and urine markings of desert gerbils at a brisk rate soon after

Table 1 Behavioural acts of desert gerbil *Mertiones hurrianae* prior to and after the release of sympatric species *Tatera indica* in the rattery (Mean \pm SE)

Social condition	Sex	Visits to burrow (n/hr)	Visits to food containers (n/hr)	Duration of stay at food containers (sec/hr)	Visits to water containers (n/hr)	Duration of stay at water containers (sec/hr)	Scent marking (n/hr)	Urine marking (n/hr)	Sand bathing (n/hr)	Thumping (n/hr)
Prior to release of <i>T. indica</i>	Male	9.46 ± 0.67	2.33 ± 0.80	113.26 ± 17.56	0.75 ± 0.12	25.11 ± 1.59	2.54 ± 0.60	0.59 ± 0.05	0.95 ± 0.09	0.78 ± 0.06
	Male	8.24 ± 0.34	3.44 ± 0.56	209.83* ± 29.95	0.58** ± 0.02	19.45* ± 1.21	3.96* ± 0.34	0.64 ± 0.10	0.46** ± 0.12	1.69 ± 0.49
Prior to release of <i>T. indica</i>	Female	9.22 ± 0.61	1.46 ± 0.15	90.61 ± 13.15	0.64 ± 0.05	22.88 ± 4.52	1.47 ± 0.24	1.05 ± 0.02	1.06 ± 0.06	0.56 ± 0.01
	Female	7.90 ± 0.28	1.86 ± 0.19	99.08 ± 15.63	0.63 ± 0.03	23.77 ± 1.07	3.22** ± 0.36	0.81 ± 0.18	0.57** ± 0.04	0.77 ± 0.35

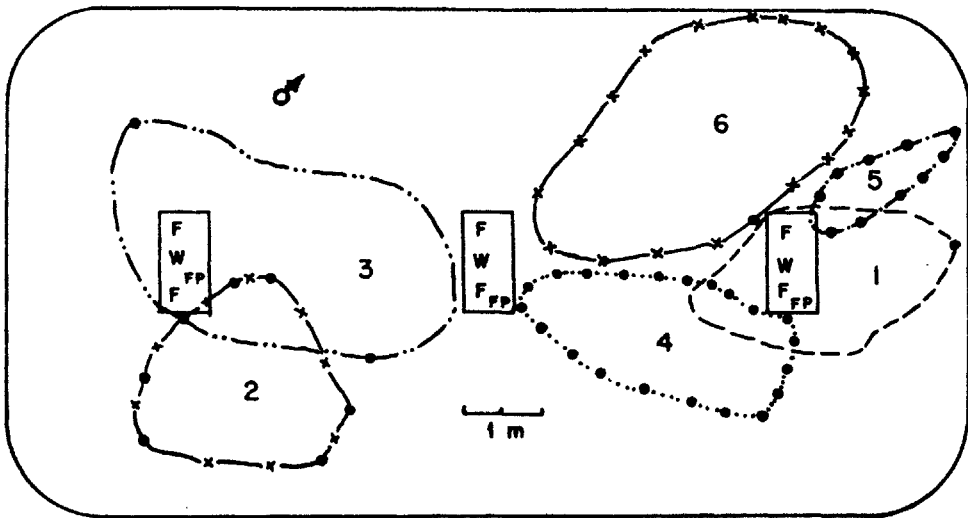
Students' 't' test between the two social conditions

Level of significance: * $P < 0.05$ ** $P < 0.01$



FP = FEEDING PLATFORM
F = FOOD W = WATER

Figure 1 Range of movement of male *M. hurrianae* in the rattery, prior to release of sympatric *Tatera indica*



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Figure 2 Range of movement of female *M. hurrianae* in the rattery, prior to release of sympatric *Tatera indica*

venturing out of their burrows after dusk. From the habit of Indian gerbils to select sites for their own markings which already carried the sebum odour of the other species, it appeared that they were attempting to superimpose their own odours on that of desert gerbils. Conversely, in the morning, desert gerbils used to sniff and scent mark the points carrying odours of Indian gerbils.

The number of intraspecific interactions among desert gerbils were drastically reduced ($P < 0.001$) after the release of the Indian gerbils. It was also observed that, after release of the Indian gerbils in the rattery, range of movements of the residential population of desert gerbils declined significantly ($P < 0.01$, table 2). The average area of their home range was reduced from $36.46 \pm 6.47 \text{ m}^2$ to $13.75 \pm 6.48 \text{ m}^2$ in males and from 40.45 to 17.08 m^2 in females. However, one female (No. 3) which was initially low in scent marking hierarchy increased its movement range (table 2). A number of ranges of desert gerbils were totally shifted from one side of the rattery to the other (figures 1-4) after the release of Indian gerbils.

The introduction of equal number of Indian gerbils in the colony of desert gerbils also affected the visits of *Meriones hurrianae* to food and water containers and their duration of stay at these points. The increase in the frequency of visits to food containers by both the male and female desert gerbils was not however significant. Likewise the duration of stay at food containers increased in both the sexes of *M. hurrianae* but significant ($P < 0.05$, 0.01) difference was observed only in case of male animals. By contrast, the number of visits and duration of stay at water containers decreased significantly ($P < 0.05$) in case of male *M. hurrianae* (table 1). However, the scent marking activity increased significantly ($P < 0.05$, 0.01) in both sexes of *M. hurrianae* due to the presence of odours of *T. indica* in the general environment of their movements.

However, urine marking activity increased ($P < 0.05$) only in the males and declined in female *M. hurrianae*. Expectedly, the frequency of thumping, which is considered as a sort of 'alarm call' (Fitzwater & Prakash 1969), also increased, especially among male *M. hurrianae*. The frequency of sand bathing, however, declined significantly ($P < 0.01$) in both sexes after the introduction of *T. indica* in the rattery.

Table 2 Ranges of movement of *Meriones hurrianae* in the rattery and their body weight

Sex/No.	Body wt (g)	Prior to release of <i>T. indica</i> (m^2)	After the general area was impregnated with <i>T. indica</i> odours (m^2)	
Male	1	86	49.50	10.60
	2	103	43.00	12.30
	3	86	32.10	23.00
	4	78	38.00	10.00
	5	73	22.00	6.30
	6	95	50.00	20.30
			39.06	13.75**
			± 4.84	± 2.90
Female	1	82	52.50	18.50
	2	66	62.20	32.10
	3	76	8.00	26.50
	4	76	62.50	6.80
	5	66	18.50	7.10
	6	100	39.00	11.50
			40.45	17.08**
			± 9.41	± 4.30

Students' 't' test, level of significance

** $P < 0.01$

Table 3 Total number of intra-specific aggressive acts initiated by individual *Meriones hurrianae* prior to and after the release of *T. indica* in the rattery

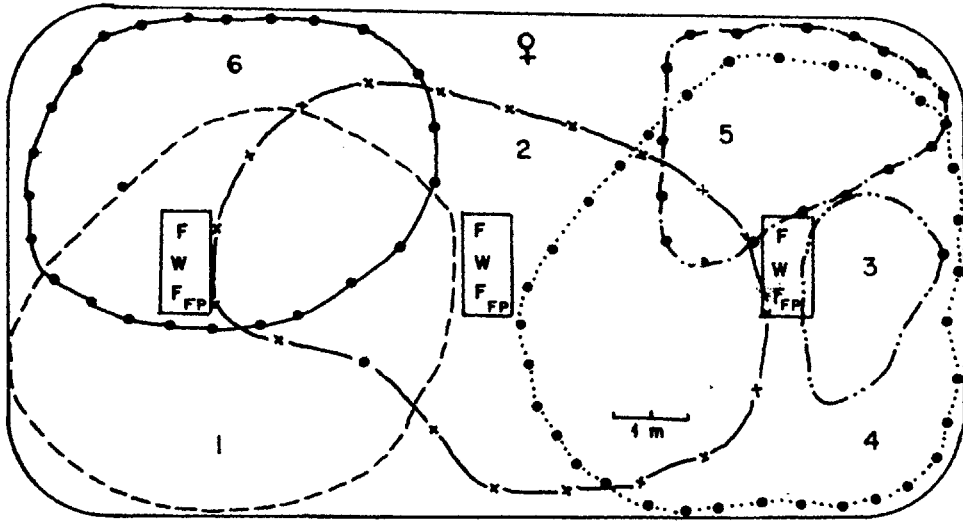
Social condition	Sex	Fighting	Chasing	Following	Total	Chi ² ₁	P
Prior to release of <i>T. indica</i>	Male	44	134	26	204	22.36	<0.001
After the release of <i>T. indica</i>		20	90	9	119		
Prior to release of <i>T. indica</i>	Female	31	108	15	154	29.74	<0.001
After the release of <i>T. indica</i>		10	56	6	72		

Discussion

The significant change observed in the behaviour of *M. hurrianae* after the release of *T. indica* in the rattery was the enhancement of the frequency of former's scent marking activity, in both males and females ($P < 0.05$ and $P < 0.01$). However, the urine marking frequency was enhanced ($P < 0.05$) only in case of male *M. hurrianae*. It has been observed earlier in both species (Kumari & Prakash 1981, Idris & Prakash 1982) that scent marking as well as urine marking activities increase in presence of conspecific odour of sebum/urine in their immediate environment, both the sexes preferring unisex odours (Kumari & Prakash 1981, Idris & Prakash 1982). Moreover, it has also been observed that in *Meriones* colonies, the dominant males and the only dominant female perform maximum scent marking (Kumari & Prakash 1981a). In the context of these behavioural observations it may be quite possible that the significant enhancement of scent marking activity in *M. hurrianae* due to the presence of odours of *T. indica* may be to ensure their dominance status or may be for dominance display.

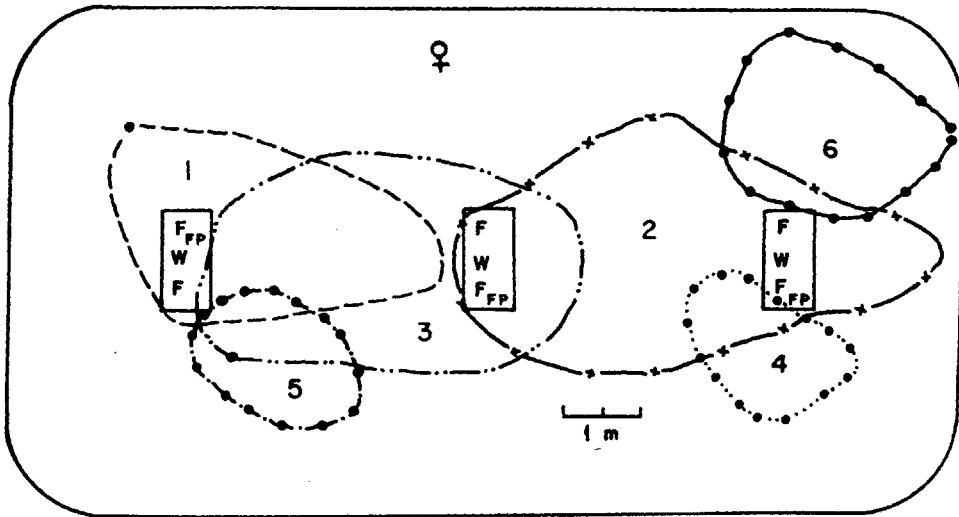
One of the functions of scent marking by the gerbils may be to "enhance their confidence" in the environment (Ewer 1968) or to provide "homeliness" to the animals

(Mykytowycz 1968) or to signal 'home' to the marking animals (Daly 1977, Idris & Prakash 1982). In the context of these observations, the significant shrinkage in the home range area of resident *M. hurrianae* (figures 3 and 4) after *T. indica* settled in the rattery, assumes significance. The observations repeatedly recorded on the behaviour of both species that after venturing out of their burrows, they used to sniff and explore the general area of their movements and superimpose their own sebum/urine odours over that of the other species indicate that *M. hurrianae* was unable to saturate the entire initial home range with its odours in spite of significantly increasing the scent marking activity (table 1), and, therefore, it had to restrict its range of movement (table 2). These observations support the hypothesis that the owner of a territory should scent mark it in a way that maximizes the chance that scent-marks are detected by the intruder and that the owner should remove or replace scent-marks in the territory that do not match its own odour (Gosling 1982). In an attempt to match the iron odour with that of the intruder, *M. hurrianae* probably minimised the range of their movement in order to saturate it with own odours, which might have been possible only in a smaller space. The enhanced odour of the owner of the territory may assist it in



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Figure 3 Range of movement of male *M. hurrianae* in the rattery, after the release of sympatric *Tatera indica*



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Figure 4 Range of movement of female *M. hurrianae* in the rattery, after the release of sympatric *Tatera indica*

escalating the competition for the intruder species and may induce it to withdraw. Hence, scent marking could provide an advantage to the occupant of a range in repelling the intruders.

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