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Rhythmic oscillations in non-aggressive social behaviour in *Bandicota bengalensis*

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Abstract. Non-aggressive social behaviour rhythms of *Bandicota bengalensis* were studied in the laboratory. The species exhibited 95% rhythmicity for social behaviour but the rhythms were uni- or bimodal and were influenced by the number and sex of interacting conspecifics. Peaks occurred at 0900 and 1800 hr. Males were more socially active than females.

Keywords. *Bandicota bengalensis* ; social behaviour ; rhythms ; unimodal ; bimodal.

1. Introduction

The lesser bandicoot rat, *Bandicota bengalensis*, is a widely distributed pest both in agricultural fields as well as in warehouses in India, Nepal, Burma, Thailand, Sri Lanka, Indonesia and Vietnam (Barnett and Prakash 1975). In spite of being a major rodent pest, its behaviour has not been sufficiently investigated (Spillet 1968; Parrack and Thomas 1970). Here we describe its non-aggressive social behaviour rhythms observed under laboratory conditions. Rhythms of aggressive behaviour have been reported elsewhere (Sridhara and Krishnamoorthy, in press).

2. Material and methods

2.1 *Animals*

Bandicota bengalensis in the weight range of 200–250 g were collected from fields by digging their burrows. On transport to laboratory the subjects were maintained in 35 × 35 × 50 cm galvanized iron mesh cages for 15 days to acclimate them to the laboratory conditions. During this period they were fed on standard rat and mouse feed (Hindustan Lever, India). Vitamins through water and fresh vegetables were made available once a week. The photoperiod was regulated at 12 hr light and 12 hr darkness with the former beginning at 0600 hr. Room temperature was 25 ± 3° C.

2.2 *Behaviour studies*

The non-aggressive social behaviour under different social conditions, such as confrontation between male–female, male–male, female–female, one male–two females, one male–three females, two males–one female and three males–one female was observed, and the rhythmicity for each sex was noted. The parameters of non-aggressive social behaviour were the frequency of occurrence of several acts and postures namely attend, approach, nosing, nose-nose, investigate, ano-genital sniffing, push-past, crawling under/over, huddling, allogrooming and the various sexual activities like following, attempted mount, mount, intromission, ejaculation, post-copulatory groom and lordosis. The terms and identification of behaviour patterns were based on the studies of Grant and Mackintosh (1963), Ewer (1971), Barnett (1975), Begg and Nelson (1977) and Beach (1976).

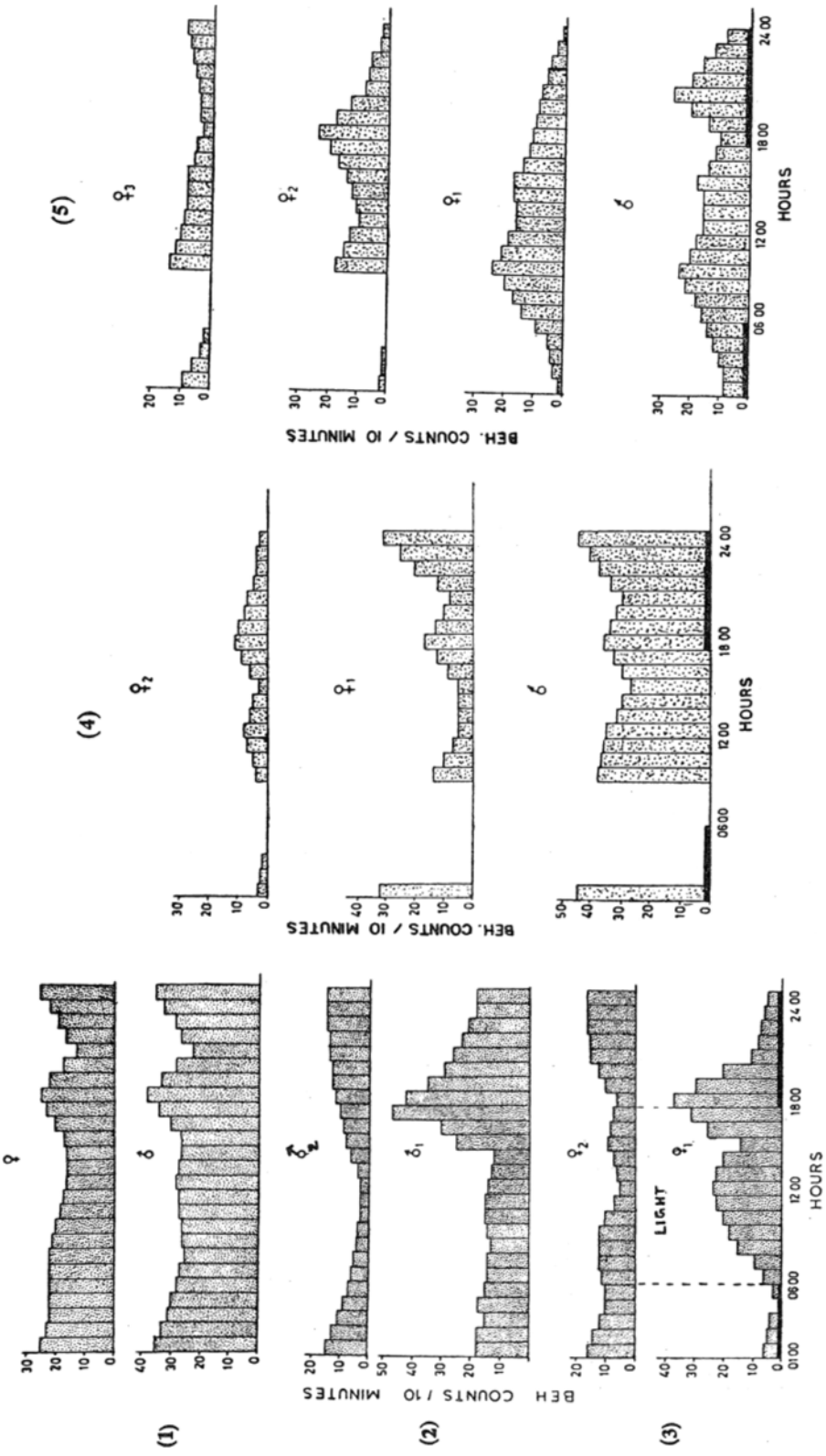
For studying behaviour the subjects were transported to a 100 × 50 × 50 cm observation chamber, made of galvanised iron with glass sides and front. The roof of the cage was made of wire mesh. The sides were of sliding type to facilitate easy introduction of animals. The chamber was divisible into two equal portions by inserting a thin galvanized iron sheet into the slot at the centre of the roof. The two sexes of different combinations were isolated in these portions for 5–6 days prior to the study to habituate them to the test chamber. During observations on social behaviour, the partition was removed for 10 minutes, the acts and postures of non-aggressive social behaviour scored for each individual during the ensuing interaction. Rhythms were established after collecting data during each hour of the L.D. cycle over a schedule of seven days. The observations were made under natural light during day-time and under dim red light during nights. The light was kept 2 M away from the cages.

2.3. *Statistics*

The cumulative means of each individual were computed into histograms (figures 1–5). The mean ± S.E. of behaviour scores of the two sexes were subjected to student *t* test to establish which of the sex is more active socially in the various confrontations. For group encounters Krushkal–Wallis one way analysis of variance (Siegel 1956) was carried out to determine the rank order of sociability amongst the interacting individuals.

3. Results

Except in females of group encounters all the subjects were socially active throughout the 24 hr L.D. cycle. The results presented in figures 1–5 indicate that *B. bengalensis* exhibits rhythmic social behaviour in most of the encounters. The seven day schedule of observations indicated a fairly consistent rhythmicity (95%). The rhythms were unimodal or bimodal depending on the sex and number of interacting conspecifics. For instance, male one of male–male encounter displayed a single peak at 1800 hr (figure 2) whereas the male of one male–three females group confrontation exhibited two peaks at 0900 and 2100 hr. No definite peak was seen for the two members of male–female interaction (figure 1), male



Figures 1–5. Each histogram represents the oscillatory social behaviour of an interacting individual in the cage over a 24 hr period.

two of male–male encounter (figure 2), female two of female–female pair (figure 3) and the male of one male–two females combination (figure 4). However slightly raised social activities were seen at 1800, 2300–0100, and 0100 hr respectively for these animals. Amongst females, female one and three of one male–three females group encounter exhibited a single peak of non-aggressive social behaviour at 0900 hr (figure 5) while two peaks were seen for female one of female–female interaction at 1200 and 1800 hr (figure 3), female two of one male–two females group encounter and one male–three females group confrontation. The former had peaks of social behaviour at 1200 and 1800 hr (figure 4) and the latter at 0900 and 1800 hr (figure 5). Only one female, female one of male–two females group displayed three peaks of social behaviour rhythm at 0900, 1800 and 0100 hr (figure 4). Majority of the peaks occurred at 0900 and 1800 hr for both males and females.

Between the sexes male was more active socially in male–male ($P < 0{\cdot}001$, table 1) and one male–two females encounter ($P < 0{\cdot}001$, table 1). In isosexual pairs one of the pairs was significantly more social ($P < 0{\cdot}001$ and $P > 0{\cdot}05$, table 1). The rank order of social behaviour in one male–two females group encounter was male > female one > female two ($H = 7{\cdot}93$, $P > 0{\cdot}05$) while there was no such hierarchy in the one male–three females interaction ($H = 3{\cdot}21$, $P < 0{\cdot}05$). However, female one was more sociable than female three (*t* test

Table 1. Comparison of non-aggressive behaviour scores of male and female *B. bengalensis* during different social conditions.

Confrontation between	Scored by	Mean beh. counts ± SE	Cumulative score for the combination
Male and female	Male	1393±47*	
	Female	959±42	2352
Male and male	Male one	1024±31*	
	Male two	433±52	1457
Female and female	Female one	733±49*	
	Female two	504±49	1247
One male and two females	Male	1187±98*	
	Female one	418±26	
	Female two	220±21	1819
One male and three females	Male	190±23	
	Female one	281±26**	
	Female two	213±28	
	Female three	137±14	821

* Significantly higher social activity score.

** More social than female three.

$P < 0{\cdot}01$, table 1). When group encounters involved more than one male, social behaviour was least but aggression was so violent that all males except the dominant were found dead much before the 24 hr cycle. The death seemed to be due to the stress of constant threats and fighting rather than due to injuries since none of the dead males was fatally wounded.

4. Discussion

Several species of rodents exhibit well-established rhythms for movement outside their burrows in nature (Marten 1976), activity and movement in cages and maize (Barnett *et al* 1975), and for aggressive behaviour (Lerwill 1977). These studies showed two peaks of activity for rats, one soon after dark period and a second before dawn with little activity during the day-time. A similar bimodal rhythmicity for locomotor activity was observed in *B. bengalensis* by Parrack (1966). Agonistic behaviour of a group of lesser bandicoots did not exhibit any rhythms; however, it tended to be increased between 0200 and 0530 hr (Spillet 1968). Parrack and Thomas (1970) observed dominant *B. bengalensis* exhibiting peak aggressive behaviour at 0600 and 0900 hr. This period coincided with the visit of subordinate rat to the food platform. The present results also demonstrate that non-aggressive social behaviour of *B. bengalensis* also manifests both uni- and bimodal rhythms depending on the sex and number of conspecifics interacting. Similar alteration of rhythms in response to social interaction has been demonstrated for several species of rodents. For instance, Kavanau (1967) observed synchronization of running between female deer mice, while Calhoun (1975) noticed alteration of locomotor activity by sexual rhythms in Norway rats. Our earlier study showed circadian oscillations in the aggressive behaviour of *B. bengalensis* consequent on social stress (Sridhara and Krishnamoorthy, in press). Farr and Andrews (1978) described the phase dissociation of both metabolic and behavioural rhythms of deer mice, *Peromyscus maniculatus* when crowding increased social interactions. The phase relationships of subordinate subjects was prone to be much more unstable which the authors attribute to their avoidance of more aggressive and dominant cohorts. The fluctuation in the social behaviour rhythms seen in the present study also could be due to the degree of stress experienced by the subordinate animals during the various social encounters staged.

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