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Effect of Grouping and Sex on the Estrous Regulation of a Wild Rat, Bandicota bengalensis

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ABSTRACT

Bandicoot rats in laboratory conditions show irregularity in their estrous cycle. A majority of the animals, however, manifest regularity in their cycle following all-female grouping and the presence of a male. The probable participation of a pheromone(s) in the reproduction of this wild rat is suggested.

INTRODUCTION

The timing of the estrous cycle in laboratory rats and mice may be influenced by exteroceptive factor(s) and social relationships. The latter is particularly a determinant factor in the case of mice. It has been observed that the caging together of female mice causes mutual disharmony of the estrous cycle. If the female mice remain in a crowded state, most of them manifest spontaneous pseudopregnancy (the Lee-Boot effect) or continuous diestrus (van der Lee and Boot, 1955, 1956; Whitten, 1959). Furthermore, the presence of a male induces estrus (the Whitten effect), shortens the estrous cycle and reduces the incidence of pseudopregnancy in the all-female grouped mice; these effects are independent of the physical contact between male and female (see Whitten, 1966). However, in the rat, the "Lee-Boot effect" is absent and the "Whitten effect" is negligible, although some shortening of the estrous cycle may occur in the presence of a male (Hughes, 1964).

Bandicoot rats are a widely distributed common Indian rodent which causes extensive damage of stored food in warehouses and spreads many diseases to humans (Spillett, 1968). In our previous study (Sahu and Maiti, 1978), the estrous cycle of this wild rat, when the rats were caged individually, was found to be extremely irregular in a 12L:12D schedule. To understand the factors involved in the irregularity in the cyclic phenomenon of this species, experiments were performed by "grouping" individual females in a cage, and also by introducing strange males to within close proximity of the grouped females.

MATERIALS AND METHODS

Adult female bandicoot rats, *Bandicota bengalensis* (GRAY), weighing about 150–220 g each, were trapped in grain storage godowns (warehouses) in Calcutta. They were housed in separate cages (30.5 × 15 × 10 cm) under uniform conditions in the animal room (12L:12D, lights on 0600–1800 h), with food and water ad libitum.

The estrous cycle of the rats was studied for 4 weeks by the vaginal smear technique (Zarrow et al., 1964). Vaginal smears were taken once daily between 1000–1100 h and identified (Sahu and Maiti, 1978). Duration of the estrous cycle was determined by the length of the interval between one stage and the reappearance of that same stage. The frequency of a stage was calculated as the percentage of appearance of that stage in vaginal smears taken over several weeks. Statistical analyses were done by Student's *t* test.

Experiment 1. Grouping

Rats showing a completely irregular cycle (continuous diestrus or metestrus with very few estrous smears) in 12L:12D were grouped 4 per cage (30.5 × 15 × 10 cm). After grouping, the animals were left undisturbed for 5 days and thereafter vaginal smears were taken once daily for 4 weeks without alteration of the light schedule.

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TABLE 1. Effect of grouping and male's presence on the estrous cycle of the bandicoot rat.

Experimental schedule	Frequency of stages[a]		Duration of cycle (days)	% of regularity
	Proestrus-estrus	Metestrus-diestrus		
Before grouping [12L:12D] (24)[b]	8.00 ± 2.30[c]	92.00 ± 2.30	Mainly metestrus or diestrus	Nil
↓ 4/cage (in 6 separate cages)	34.80 ± 4.70 P<0.001[d]	65.20 ± 4.70	4.31 ± 0.35	25 (60% become cyclic)
↓ Male's presence	40.55 ± 4.57 P<0.001	59.45 ± 4.56	4.19 ± 0.30	60

[a]Frequency is the percent of the particular stage out of total scores of the vaginal smears; for example in the rats before grouping, the "proestrus-estrus" smears were 8% of the total smears taken during 4 weeks.

[b]Figure in parentheses denotes the number of rats.

[c]Values are mean ± SEM.

[d]Level of significance in relation to "before grouping."

Experiment 2. Influence of a Male

Grouped females on a 12L:12D cycle were exposed to an adult male. Males were not permitted direct contact with the females but were kept in a cage placed at the side of the females' cage so that the male and females could see and smell each other. Estrous cycles were then monitored for 3 weeks.

RESULTS AND DISCUSSION

The results are incorporated in Table 1. It is evident that when the noncyclic female bandicoot rats were grouped (4/cage), a large number of individuals (60%) became cyclic and 25% exhibited a regular estrous cycle (3 or 4 days). The frequency of proestrus-estrus smears was also greatly increased. Thus, in this wild rat, grouping induced cyclic regularity and estrus. It is worth mentioning that the population density of the bandicoot rat is remarkably high in their natural habitat (Spillett, 1968). Since grouping induces the cyclic phenomenon in noncyclic females, it may be inferred that the bandicoot rat maintains regular cycles in the wild. It is highly probable that the extremely irregular cycles manifested by these rats in the laboratory is the result of isolation stress (Hatch et al., 1963; Christian et al., 1965). Logically, grouping via social interactions (presumably via pheromones) is the causative factor for induction of more regular estrous cycles in this wild rodent.

In sharp contrast to the estrous cycle suppression reported in all-female grouped mice (van der Lee and Boot, 1955, 1956; Whitten, 1959), estrous cycle acceleration was found in all-female grouped bandicoot rats. Interestingly, the Lee-Boot effect was not exhibited by the albino rat (Hughes, 1964), and this effect may be uncommon in wild populations (Whitten and Bronson, 1970).

The fact that a male's presence near the cage of grouped females induced more regularity, as well as shortening of the estrous cycle in the bandicoot rat, deserves a brief comment. This is most likely the result of the male's pheromone triggering follicle-stimulating hormone secretion (Dominic, 1969); the influence of the male is independent of direct contact with the female, as has been reported in mice (cf. Whitten, 1966). In the albino laboratory rat, the male's presence has almost no influence on the female's estrous cycle (Hughes, 1964), while in wild bandicoot species the effect of the male on the estrous cycle is quite profound.

Thus, in the present investigation, grouping and presence of a male have been identified as

two of the possible factors which can regulate the estrous cycle of this wild rat in the laboratory. Characterization of the rat pheromone(s) likely to be involved in this regulation would be of considerable interest for future investigations.

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