

# House Musk Shrews (*Suncus murinus*) Do Not Copulate in the Light Period when First Paired in the Dark

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## Summary

The copulatory behavior pattern of house musk shrews paired for 24 h starting at either 09:00 (light) or 20:00 (dark) was investigated. Ejaculatory behaviors were observed in both light and dark periods, when mating was started at 09:00. However, the males ejaculated only in the dark period when they were paired at 20:00.

## Introduction

House musk shrews (*Suncus murinus*) are known to have an alimentary canal more structurally similar to that of human beings than rats or mice (Kurohmaru, 1985), to be sensitive to motion sickness (Kaji *et al.* 1990), and to be more resistant to X-rays than C3Hf/He mice (Tsubouchi *et al.*, 1984). They have been widely used in studies on disease models for motion sickness, gastric cancer, and hematopoietic disorders. They are also expected to be models for hormone-dependent tumors because of their spontaneous, androgen-dependent pilosebaceous tumor (Itami & Takayasu 1983, 1984). Knowledge of their reproductive efficiency is needed for such research. It is considered that matured female house musk shrews with reflex ovulators are ready to mate with males at any time. Recently Hashimoto *et al.* (2004) investigated whether a male house musk shrew could impregnate more than one female within 24 h.

In the present study, we focused our attention on the appearance of ejaculation during 24 h in male house musk shrews when first paired in the light or dark.

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## Materials and Methods

### Animals

Ten sexually experienced male and female 1-year-old house musk shrews of the Jic: SUN strain were supplied from the Central Institute for Experimental Animals (Kawasaki, Japan). The animals were housed in polycarbonate cages (220 deep x 380 wide x 200 high mm) with wood shavings as bedding in an animal room kept at 24± 2° C and 55± 10% humidity with a 12:12h light:dark cycle with lighting on at 07:00. They were given CLEA-305 diet (CLEA Japan, Inc., Tokyo, Japan) and tap water *ad libitum*. All experiments were performed under the Guidelines for Animal Experimentation of the Japanese Association for Laboratory Animal Science.

### Mating systems

Each male was paired with a single female for 24 h. The male was introduced in a cage first and was followed 5 min later by a female at either 09:00 (light group) or 20:00 (dark group). Behavior was recorded with a video camera. A 6W red light bulb illuminated the cage during the dark period. The following indices of copulation were measured according to the method reported by Saito *et al.* (1997).

- 1) Mounting frequency (MF): Number of mountings without intromission during 24 h.
- 2) Intromission frequency (IF): Number of mountings with intromission during 24 h.

- 3) Ejaculation frequency (EF): Number of ejaculations during 24 h.
- 4) Mounting latency (ML): Time elapsed between introduction of the female and the first display of mounting.
- 5) Intromission latency (IL): Time elapsed between introduction of the female and the first display of intromission.
- 6) Ejaculation latency (EL): Time elapsed from the first intromission to ejaculation.

After observations of copulatory behavior, mated females were checked for delivery rate and litter size. Litter size was defined as the number of pups at 0 day after birth.

*Statistical analysis*

Differences in copulatory behavior between the two mating groups were compared with the Mann-Whitney U test, and differences in rates of delivery were analyzed with the Fisher’s exact probability test. In all tests the two groups were compared at a significance level of 0.05.

**Results and Discussion**

As shown in Figs. 1 and 2, when mating was started at 09:00 (light period) ejaculations were observed in both light and dark periods (defined as “light period patterns” in Fig. 1), while they were observed only in dark period (defined as “dark period patterns” in Fig. 2) when mating was started

at 20:00 (dark period). A copulation sequence in house musk shrews consisted of ejaculation after some mounts and intromissions. In addition, all males ejaculated in all sequences observed in this study (Figs. 1 and 2). This is similar to mice, rat, Syrian hamsters, and a former study on house musk shrews (*Hashimoto et al. 2004, Hokao et al. 1993*).

As shown in Table 1, the frequencies and latencies of copulation were not different between the light and dark groups. The delivery rate and litter size were not significantly different between the two groups (Table 2).

Saito *et al.* (1997) reported that the numbers and latencies of mounts, intromissions, and ejaculations were not significantly different when 2-h mating was started either at 09:00 (light period) or 20:00 (dark period). The copulatory behaviors were observed for 24 h in both light and dark periods, and the males ejaculated only in the dark period when they were paired at 20:00.

Such a phenomenon has never been reported in other species of animals. It is interesting to consider the cause of no ejaculations occurring in the light period when first paired in the dark. Unfortunately, the authors currently can offer no suggestions. Further studies are necessary to clarify this point.

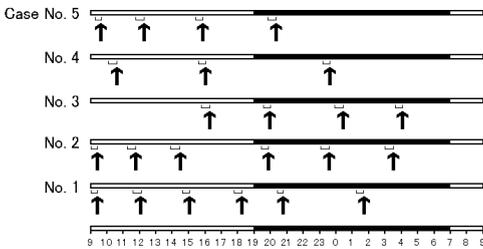


Figure 1 Copulatory behavior (ejaculation) patterns (light period patterns) when mating was started at 9:00. Arrows show the times of ejaculation. Range bars show the times mounts and intromissions were observed.

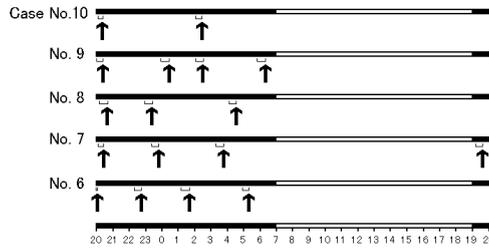


Figure 2 Copulatory behavior (ejaculation) patterns (dark period patterns) when mating was started at 20:00. Arrows show the times of ejaculation. Range bars show the times mounts and intromissions were observed.

Table 1. Comparison of behavior frequencies and latencies in males mating starting in either the light or dark periods.

Mating started at	n	No. of Mount/24h	% <sup>a)</sup>	No. of Intromission/24h	%	No. of Ejaculation/24h	%
Light	5	79 (24-210) <sup>c)</sup>	100	22 (4-45)	100	4 (3-6)	100
Dark	5	32 (23-95)	100	18 (3-27)	100	4 (2-4)	100
P value <sup>d)</sup>		ns (P>0.05) <sup>a)</sup>	ns (P>0.05)	ns (P>0.05)	ns (P>0.05)	ns (P>0.05)	ns (P>0.05)

Mating started at	n	Mount latency <sup>b)</sup>	Intromission latency	Ejaculation latency
Light	5	783(302-25561)	845(660-27243)	423(360-9783)
Dark	5	1082(0-4143)	1147(0-4149)	360(123-968)
P value		ns (P>0.05)	ns (P>0.05)	ns (P>0.05)

a) % of animals responding  
b) Latency in sec.  
c) Median (Range)  
d) Determined by Mann-Whitney U test  
e) Not significant

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Table 2 Comparison of delivery rates and litter sizes between the light and dark periods in house musk shrews

Started period	n	Deliver rate (%) <sup>b)</sup>	Litter size <sup>c)</sup>
Light	5	100	2 (1-4) <sup>a)</sup>
Dark	5	100	3 (2-4)
P value		ns (P>0.05) <sup>d)</sup>	ns (P>0.05)

a) Median (Range)  
b) Fisher's exact probability test  
c) Determined by Mann-Whitney U test  
d) Not significant

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