

# MATING PATTERNS OF FOREST-FLOOR MILLIPEDES

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**Abstract.** This study examined mating and post-copulatory behaviors of forest-floor millipedes (*Nyssodesmus python*). Trials testing male fidelity to females after copulation resulted in an equal probability of a male mating with his original partner as mating with another female, implying that there is no recognition or fidelity within the pairs. The study of the behavior of males with excess females showed no difference in the males' patterns of mating with or without competition from other males. It seems that the millipedes have fixed mating behavior, unaffected by particularities of the mating environment. (CNO)

## INTRODUCTION (JVK)

*Nyssodesmus python* is the only known millipede species to have a postcopulation riding behavior. Within the first six hours after encountering a female, the male will copulate and then ride on the back of the female for up to five days (Heisler 1983). It has been suggested that this behavior may be due to sexual selection on males. Females are receptive for long periods of time during which they will mate with as many males as they meet. Because the sperm is not used until oviposition, competition among males occurs (Heisler 1983). This could happen either by having one male displace another male's sperm in the female's storage receptacles, or by having competing sperm together in the receptacle. By riding on the female's back and inhibiting her ability to mate with other males, the male is able to protect his sperm investment. This would also ensure greater reproductive success since a male's probability of remating is low due to a low availability of solitary, reproductively active females (Heisler 1983).

If this is true, we questioned whether a male would return to his original mate after a brief separation to protect his investment, or if he would

try to mate with another female. We predicted that fidelity by males would be high because of the high competition for successful reproduction. We also questioned whether the availability of solitary receptive females affected the male's mating/riding behavior; i.e., if females are not limited, would the male mate with as many females as possible and not ride since there is less pressure to protect his sperm? We hypothesized that the reduction in competition for females would lead to an increased number of mates for males.

## METHODS (SLS)

Millipedes were collected on 8-9 February 1992 along the Sendero Occidental trail, near La Selva Biological Station, Costa Rica. Any millipedes collected as pairs or triplets were kept together as found but separated from other pairs or triplets. Single individuals were kept in either all male or all female containers until the actual tests were conducted. All individuals were marked with Liquid Paper® for identification purposes.

To test male fidelity to females, two known pairs of mates (assuming that a male found with a female was her most recent mate) were separated

from their mounted position and placed in a single chamber ~25cm x 25cm. Twenty-nine replicates were conducted. We observed the millipedes every half hour for four hours and recorded any matings or ridings that occurred during that time.

We tested our hypothesis that males would mate with multiple females if they were in excess by placing a solitary male in a chamber with two females, neither of which was his original mate. As a control for this situation we bound one male with thread to the side of the chamber in order to observe the effects of his presence without his ability to mate with or ride either female. Again, one unbound male and two females were placed together in these chambers. Sixteen replicates of the control and 19 of the manipulation were conducted. Matings and ridings were recorded every half hour for four hours in each chamber. Some of the replicates of all three experiments involved individuals that had been used in previous trials, however there was never a replicate of the same combination of individuals in a single chamber.

## RESULTS (JVK)

A total of 68 male/female pairs and 11 solitary millipedes (7 males, 4 females) were found. Three triplets (male on a male on a female) were also found and separated to be used as solitaires.

Of the males tested for fidelity, 45 of 58 males were observed riding a female. 25 of these males rode their previous mates and 20 rode a different female, thus showing no significant

fidelity to previous mates by males ( $\chi^2=0.556$ ,  $p>1$ ; Table 1).

Table 1. Fidelity of male millipedes to original mates

	with orig. mate	with new mate
#of males mating /riding	25	20
$\chi^2=0.556$ , $p>1$		

We did not get a sufficient amount of data to test our second hypothesis. Twelve males mated once and 1 male mated twice out of 19 trials, while 6 males mated once and 1 male mated twice in 16 control attempts (Table 2). A separate analysis on the effects of another male's presence on whether a male will mate or not was insignificant ( $\chi^2=2.073$ ,  $p>1$ ; Table 3).

Table 2. Effect of another male's presence on male millipede promiscuity.

	mated with only 1 female	mated with both females
1 male present	12	1
2 males present but one detained	6	1
insufficient data collected for analysis		

Table 3. Effect of another male's presence on whether they mate or not.

	mating occurred	no mating occurred
1 male present	13	6
2 males present but one detained	7	9
$\chi^2=2.073$ , $p>1$		

## DISCUSSION (SLS)

We could not reject the null hypothesis that a male will return to his last mate as often as he will mate with another receptive female in a two male, two female system. Therefore, we have no support for our theory that there is fidelity in males in order to protect their investment of sperm. We believe that the riding posture is most likely an instinctive behavior at any encounter with another millipede. We observed several occasions in which a male rode another male and ones in which a male would ride a female without copulating. There also appears to be no recognition of previous mates by the male since we observed some males copulating with a female with which he had just mated.

Because of the small number of matings that actually occurred in our second experiment, we could not conclude that a male will actually mate with more females in the absence of male competition. We did, however, notice (although not significantly) that

there is a decrease in the total number of matings when another male is present. We believe that in both of these cases, limited time may have been a factor in the low number of observed copulations. Further studies should include many more replicates for longer periods of observation.

Captivity conditions (artificial habitat, time of day and reuse of experimental subjects) may have altered the activity of the millipedes in this experiment. Future students may wish to conduct similar research in natural settings. The results of these experiments apply to laboratory settings only and one should be cautious when extrapolating the results to natural conditions.

## LITERATURE CITED

- Heisler, I. L. 1983. *Nyssodesmus python*. In *Costa Rican Natural History*, ed. D. H. Janzen, 747-49. Chicago: University of Chicago Press.