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SHORT COMMUNICATION

COHABITATION BETWEEN AN ADULT MALE AND A SUBADULT FEMALE IN A BURROWING WOLF SPIDER (ARANEAE, LYCOSIDAE)

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ABSTRACT. We report a case of cohabitation between an adult male and a conspecific subadult female *Lycosa tarantula* (Linnaeus 1758) (Araneae, Lycosidae). Cohabitation was observed during a field study in a population near Madrid city (central Spain). The male was first observed in the female burrow four days before the female maturation molt. Both individuals remained together until female maturation occurred. Mating occurred two days after female maturation, at a much younger age than non-cohabiting females. The possible mechanisms by which adult males find subadult female burrows are discussed.

RESUMEN. Describimos un caso de cohabitación entre un macho adulto y una hembra subadulta de *Lycosa tarantula* (Linnaeus 1758) (Araneae, Lycosidae). Observamos la cohabitación durante un estudio de campo realizado cerca de la ciudad de Madrid, en el centro de España. Encontramos por primera vez al macho en el interior del nido de la hembra cuatro días antes de la maduración de ésta. Los dos animales permanecieron en el nido todo ese tiempo, y se aparearon dos días después de la muda de maduración de la hembra. Esto ocurrió a una edad muy inferior a la de las hembras que no cohabitaron con ningún macho. Discutimos los posibles mecanismos por los que los machos adultos encuentran los nidos de las hembras subadultas.

Keywords: Sexual cohabitation, Lycosidae, *Lycosa*

Sexual cohabitation, in the general sense of a male and a female dwelling together, is a relatively widespread phenomenon in spiders (Jackson 1986). It has been described in many families and genera, including araneids (Fahey & Elgar 1997), eresids (Schneider 1997), salticids (Jackson & Mcnab 1991; Jackson 1995), linyphiids (Suter & Walberer 1989; Suter & Sánchez 1991) and lycosids (Miller & Miller 1986, 1987).

Descriptions of sexual cohabitation are rather diverse and include situations in which adult males are found in the webs of adult females for more time than required for copulation (Suter & Walberger 1989; Suter & Sánchez 1991), and those in which adult males are found dwelling with subadult females (Miller & Miller 1986, 1987; Fahey & Elgar 1997; Schneider 1997). If there is first male sperm priority and the female reproductive status is difficult to assess, cohabitation between adult males and subadult females may be interpreted as a sort of pre-mating mate guarding. It would increase the male reproductive success by maximizing male paternity and preventing other males from inseminating a virgin female before the cohabiting male (Jackson 1986).

The occurrence of pre-mating cohabitation between adult males and subadult females may be constrained by several factors: (1) the overlapping of male and female maturation (Schneider 1997), (2) the male inability to assess the female developmental state, (3) the aggressiveness of subadult females towards males and (4) the lack of female sedentarism. Lycosids are commonly vagrant species, which would constrain pre-mating cohabitation in this family. However, a few lycosid species have adopted a life history in which immature individuals and adult females use burrows. In such species, mature males wander in search of females during the time of reproduction. Probably due to these sedentary habits, pre-mating cohabitation of adult males and subadult females has only been reported in burrowing lycosid species (*Geolycosa tu-*

Figure 1.—An adult male *Lycosa tarantula* at the entrance of the burrow of a subadult conspecific female, which can be observed beneath. In preparation for the photograph, the male was extracted from the female burrow, but the resulting posture is similar for the male when undisturbed. Initially, the male showed a highly aggressive response, while the female remained inside the burrow.

rricola (Treat 1880) Miller & Miller 1986, 1987). The description of cohabitation in *G. turricola* consisted of the finding of several males positioned face down at the entrance of female burrows during evening visits. In the lab, the extracted females turned out to be subadults. However, the authors were not able to report for how long adult males remain with subadult females in the field, nor could they describe the mechanisms used by males in finding females. In this note, we report the occurrence of pre-mating cohabitation between adult males and subadult females in another burrowing wolf spider (*Lycosa tarantula* (Linnaeus 1758)), consisting of a male who was observed to reside in the burrow of a subadult female continuously for six days. Contrary to vagrant males found to occupy burrows constructed by others, this male was not in the burrow for only a single day, and the burrow was not empty. We hypothesize that male *L. tarantula* may use tactochemical cues in finding subadult females.

In 1998, we conducted field observations as part of an ongoing study concerning the life history of this species in a 400 m^2 study plot located in Madrid (40°34′ N, 3°42′ W, central Spain). We visited the study plot twice daily for 56 d, comprising the whole mating season of the spiders. In this area, the species shows a relatively long post-embryonic development of 22 months, about 16 molts. Subadults of both sexes are sedentary, and males become vagrant after the maturation molt. We were able to follow the reproductive behavior of 18 subadults (9 males and 9 females). Thirty-six adult males were also followed. Spiders were captured by hand and individually marked with enamel by using a unique combination of yellow marks on their legs (Moya-Laraño 1999). Prior to marking, spiders were immobilized using a fine mesh and a drop of enamel was placed on the dorsal surface of 1 or 2 leg segments. Each leg segment corresponded to a numeric code, ranging from 1 to 9 (right legs) and 10 to 90 (left legs). The day of maturation was determined by the presence of the exuvia nearby the burrow entrance. Eight subadult females survived until maturation, and six of them survived until reproduction.

We recorded cohabitation of one adult male with one subadult female (11%, $n = 9$) in the female's burrow. The period of cohabitation was 6 complete days (a complete day was recorded when the spider was seen in the burrow at both the morning and the evening visits), and started 4 days before female maturation. The male generally exhibited a position at the upper part of the burrow and facing out (see Figure 1). It was extremely aggressive in response to our presence or manipulation. The two spiders

mated two days after female maturation. Soon after mating took place, the male left the burrow and started searching for a new female almost immediately. The male was observed to mate with a second female the following day.

Mating between the cohabiting pair was remarkable because the age at which the cohabiting female mated (2 d post-maturation molt, this study) was younger than that recorded both for non-cohabiting females in the same area (4–9 d post-maturation molt, pers. obs.) and for females kept under laboratory conditions (3–13 d post-maturation molt, pers. obs.). Furthermore, the cohabiting female did not mate with a second male. Our data revealed that 40% of non-cohabiting marked females in the field mated with two different males in the season. This indicates that the benefits of cohabitation for males could be related to ensuring the fertilization of a virgin female and perhaps also to reducing the likelihood that a female will mate a second time. The fertilization of a virgin female would secure the male's paternity only if there is strict first male sperm priority (Austad 1984), something that has not been completely demonstrated. Reduction of the likelihood of a female second mating might secure male paternity if there is sperm mixing.

The possible counterbalance costs for males may be twofold: (1) loss of mating opportunities, resulting from time spent during cohabitation, and (2) risks of being eaten by the host female. Sexual cannibalism by subadult females has been recorded during mating experiments in the lab (pers. obs.). However, in the case reported here, these costs were absent, since the cohabiting male was the only male observed to mate twice in the area ($n = 7$) and the female did not cannibalize the male.

Given the high benefits and the low costs, it is unclear why pre-courtship cohabitation rate was so low in our population. We suggest that molting synchrony between sexes is likely to be the underlying ecological factor influencing the occurrence of this phenomenon. Overall, males did not mature significantly earlier than females. As males spent a few additional days in their burrows before starting to search for females, their opportunities of finding subadult females might have been highly reduced.

In laboratory experiments, the interception of subadult female burrow silk elicits a strong courtship response by males. Available information suggests that males are unable to discriminate the developmental state of the females using chemical compounds bound to the female silk (Fernández-Montraveta & Ruano-Bellido 2000). Consequently, we hypothesize that the interception of burrow silk by males is a mechanism by which males may detect subadult female burrows in the field.

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