

SHORT COMMUNICATION

Silk release by copulating *Schizocosa malitiosa* males (Araneae, Lycosidae): a bridal veil?

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Abstract. We report release of silk threads by males of *Schizocosa malitiosa* (Tullgren 1905) during copulation. The silk is deposited over the female's front legs and near her mouthparts. Possible functions for this behavior could be inhibiting female aggressiveness through chemicals deposited on the silk, inducing female catalepsy during copulation or repelling other males. We propose future studies manipulating male silk release to test these hypotheses.

Keywords: Wolf spider, tying-behavior, female aggression, cannibalism

Many spiders release draglines when walking, anchored to the substrate at intervals by attachment discs (Foelix 1996). In some cases, males can release silk threads over females during courtship or copulation. This was first reported by Bristowe (1958) in the thomisid *Xysticus cristatus* (Clerck 1757). He defined the bridal veil as the silk lines deposited by males over females during courtship or copulation. Species from at least 7 families of spiders have demonstrated male silk release during copulation (Table 1).

Schizocosa malitiosa (Tullgren 1905) is a medium-sized wolf spider (average body length: 17 mm in males and 23 mm in females) that is very common in Southern Uruguay. Males follow female silk draglines and perform an elaborate courtship that includes visual and vibratory signals (Costa 1975). Males also release draglines while they walk, but silk release during courtship has not been observed (F.G. Costa and A. Aisenberg, pers. obs.). Copulation takes place in the typical lycosid mating position, with the male on top of the female facing opposite her (Costa 1979). Duration of copulation is approximately 90 min, averaging 300 palpal insertions distributed in two consecutive patterns (Costa 1979). The first copulatory pattern consists of multiple insertions with the same palp, side shift, multiple insertions with the other palp, and so on, during approximately 40 min. The number of insertions gradually diminishes until they transform into alternate use of palps after a single insertion, which constitute the second copulatory pattern, persisting until dismount. After males dismount, females can remain motionless in a cataleptic state for varying periods (several sec up to 40 min) (Costa 1979). This cataleptic state is not correlated with copulation duration, number of palpal insertions, or side shifts (Aisenberg & Costa 2005).

Occasional observations had revealed that males could deposit silk lines over the females' legs (F.G. Costa and A. Aisenberg, pers. obs.). In spite of many years working on *S. malitiosa*, this behavior had never been described before and such behavior had also not been reported previously in Lycosidae. Therefore, we decided to quantify the occurrence of male "tying" behavior in *S. malitiosa* under laboratory conditions.

Adult males and subadult individuals of *S. malitiosa* were collected in Marindia, Canelones, Uruguay (34°46'49.9"S, 55°49'34.1"W), from March to July 2006. Spiders were individually housed in culture dishes (9.5 cm diam. × 1.5 cm height), each with cotton moistened with water. Individuals were fed ad libitum with juvenile cockroaches (*Blattica dubia*, Blattaria, Blaberidae) and mealworms (larval *Tenebrio* sp., Coleoptera, Tenebrionidae). Room temperature during the breeding period averaged 19.8 ± 1.8° C (Mean ± SD, range = 14.0–26.0° C). Juveniles were maintained in a warmed room (22.7° ±

0.7° C, range = 21.5–24.5° C) as a way to accelerate their development. The average temperature during the trials was 21.7 ± 1.9° C (range = 19.5–26.0° C).

We performed 20 trials under laboratory conditions. Spiders were randomly assigned to each sexual encounter. In all the cases, we used virgin females and adults of at least 11 da of adult age, or 10 da after their capture in the field. We did not reuse individuals in the trials. The test arenas were square glass containers (29.5 cm × 29.5 cm × 9.5 cm) with sand and small pebbles as substrate. We provided four wooden blocks (each 6 cm × 1 cm × 1 cm) to enrich the area and provide potential refuges. Females were placed in the arena 48 h prior to the trial, allowing the deposition of contact pheromones with the draglines. Males were carefully introduced into the arena and removed after 20 min without courtship, 30 min when males courted but did not copulate, or after the end of copulation. The course of sexual behavior was followed by direct observation by two observers: one registered the number of insertions and side shifts and the second observer registered the durations and the occurrence of silk release. Voucher specimens were deposited in the arachnological collection of Sección Entomología, Facultad de Ciencias, Montevideo, Uruguay.

We obtained 15 copulations from the 20 pairings and in all the cases males were observed spinning silk over the female during copulation. Copulatory characteristics coincided with those reported by Costa (1979). Each male bent his abdomen downward and actively attached silk lines to the substrate (small pebbles or wooden chops), on top of female legs I and II, or close to her mouthparts (Fig. 1). The silk thread and movements of spinnerets were continuously observed during both copulatory patterns and until the end of the copulation. In 10 cases, the female remained cataleptic after copulation.

We conclude that *S. malitiosa* males regularly release silk during copulation. Possibly, two facts explain why this behavior had not been reported before. First, the inclusion of pebbles and wooden chops on the substrate for the first time allowed the attachment of male silk strands during the side shift movements, making the silk more visible. Current studies confirm the occurrence of male silk release during copulation using diverse substrates and experimental cages (A. Aisenberg, pers. obs.). Second, the observations were performed by two observers, one on each side of the test arena, which resulted in more detailed observations. Apparently, the copulating males continue releasing draglines and attachments during copulation similar to their behavior when they walk (F.G. Costa and A. Aisenberg, pers. obs.).

Various hypotheses have been proposed to explain the possible functions of male "tying" behavior, including inhibition of female

Table 1.—Spider species showing male silk release during copulation according to published studies.

Family	Species	Reference
Ctenidae	<i>Cupiennius coccineus</i> F.O. Pickard-Cambridge 1901	Schmitt (1992)
Dictynidae	<i>Dictyna volucripes</i> Keyserling 1881	Starr (1988)
Homalonychidae	<i>Homalonychus theologus</i> Chamberlin 1924	Domínguez & Jiménez (2005)
Nephilidae	<i>Nephila pilipes</i> (Fabricius 1793) (formerly <i>N. maculata</i>)	Farr (1977); Robinson & Robinson (1980)
Pisauridae	<i>Ancylometes bogotensis</i> (Keyserling 1877)	Merrett (1988)
Pisauridae	<i>Pisaurina mira</i> (Walckenaer 1837)	Bruce & Carico (1988)
Theridiidae	<i>Latrodectus hesperus</i> Chamberlin & Ivie 1935	Ross & Smith (1979)
Theridiidae	<i>Latrodectus tredecimguttatus</i> (Rossi 1790)	Stern & Kullmann (1981)
Thomisidae	<i>Xysticus cristatus</i> (Clerck 1757)	Bristowe (1958)

aggressiveness (Schmitt 1992; Domínguez & Jiménez 2005), or bridal veiling as a displacement activity arising from the conflict of mating a potentially predatory partner (Schmitt 1992). Additionally, it has been proposed that bridal veils are involved in female identification of mating partners by male pheromones deposited in the silk (Ross & Smith 1979). In *S. malitiosa*, the silk lines are deposited over or near the dorsal side of the female's front legs, which are known to present numerous chemoreceptors in spiders (Foelix 1996; Barth 2002).

Ayyagari & Tietjen (1987) suggested male pheromones function as repellents for other males in the wolf spider *Schizocosa ocreata* (Hentz 1844). According to this hypothesis, bridal veils could function as porters of male pheromones. Becker et al. (2005) reported the use of male chemical signals as elicitors of female quiescence (catalepsy) during copulation in the agelenid *Agelenopsis aperta* (Gertsch 1934). In *S. malitiosa*, this hypothesis could not be tested because all males released silk but some females remained cataleptic and others did not. The determinants and functions of female catalepsy in this species remain obscure.

Nevertheless, studies on these topics are scarce and hypotheses require further testing. Peretti & Córdoba-Aguilar (2007) have stressed the importance of fine-scaled behavioral observations for studies on sexual selection. Possibly, more detailed observations of spider courtship and copulation will contribute new cases of males that "tie" females during courtship or copulation, suggesting that this could be a widespread behavior in spiders. Future experiments sealing

male spinnerets and investigating variations on the mating pattern and female agonistic behavior, as well as studying male-male competition with and without copulatory silk lines, will help elucidate the possible functions of this behavior.

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Figure 1.—Copulation of *Schizocosa malitiosa*, with the male lying on top of the female. Note the white spot of silk on the pebble located under the male spinnerets.

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