

Observations on the mating behaviour of the tiny mygalomorph spider, *Microhexura montivaga* Crosby & Bishop (Araneae, Dipluridae)

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Introduction

The two species of *Microhexura* are especially distinctive diplurid spiders because of their small body size (under 6 mm long), cold temperate forest habitat, and longitudinal fovea (Coyle, 1981). In this paper I describe, for the first time, observations on the mating behaviour of *Microhexura montivaga* Crosby & Bishop, a species that lives in irregular flattened tube webs under moss and litter mats in the spruce-fir forests of the highest southern Appalachian peaks in the United States. Although these observations are far from complete, their significance derives in part from the fact that mating behaviour descriptions exist for only two other genera of Dipluridae, *Euagrus* (Coyle, in press) and *Australothele* (Raven, in prep.), and only one genus, *Atrax* (Hickman, 1964), in the sister family, Hexathelidae.

Methods

The two males and three females used in this study were collected on 30 September 1983 on the North Carolina side of Clingman's Dome in the Great Smoky Mountain National Park, then observed in the laboratory until they were sacrificed for silk gland studies on 3 November 1983. Each male was kept in a vial containing a piece of moist paper towelling. Each female was kept in its own covered Stender dish (a clear, glass culture dish, 50 mm diameter x 25 mm high) with a piece of moist paper towelling covering the floor of the dish. These females spun their webs on top of this towelling around the periphery of the dish. Each courtship/mating encounter was initiated by placing a male in the middle of a female's dish. Observations were made using a 10x hand lens and a Wild M5 stereomicroscope at 12x and 24x with low light intensity. Data were talked into a tape recorder, photographs were

taken through the microscope, and sketches were made immediately after each encounter. Thirteen encounters were initiated at various times of day and night, all between 3 October and 1 November; these resulted in nine couplings (six of which resulted in copulation) on eight different days.

Results

Pre-coupling behaviour

Invariably, upon first contact with the female web, the male began to move excitedly over and through it, making frequent turns and brief pauses. In two encounters coupling occurred almost immediately without any apparent courtship signalling. Typically, however, coupling did not occur until the male had performed irregularly spaced bouts of jerky up and down movements of his entire body while exploring the female's web. Each bout commonly consisted of two to four jerks spaced about 0.5 s apart. Each jerk involved more movement in the pedipalps, first legs and abdomen than in the rest of the body, and a quivering of the pedipalps was sometimes visible after the final jerk of a bout. During three of the long encounters (20-30 minutes) that did not result in coupling, the female occasionally performed jerky movements somewhat like those of the male and, after retreating from the approaching male, would apply silk to her web. Less often, the male would also apply silk.

Coupling behaviour and copulation

The onset of coupling normally involved brief (1-4 s) anterior leg grappling by both partners while

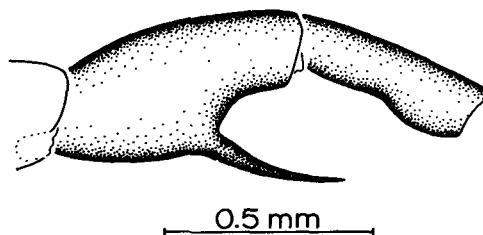


Fig. 1: Retrolateral view (with setae not drawn) of tibia and metatarsus of right leg I of *Microhexura montivaga* male showing the tibial spur and metatarsus modifications used in clasping the pedipalp femur of the female during mating.

in a front-to-front position with their cephalothoraxes raised. During one such grappling interaction lasting 3-4 s, the female's fangs were extended for a few moments. One pair grappled for 10 s before becoming firmly coupled and eventually copulating. In every coupled pair the tibia I claspers (Fig. 1) of the male were forced around the base of the female's pedipalp femora (Fig. 2) (except for one female with a missing left palpus which, on her left side, was clasped at the base of her first leg). The coupled partners (Fig. 2) were front-to-front with the female's cephalothorax inclined above the male's. The second legs of the male were usually held above the pedipalps and first legs of the female, while male legs III and IV supported the male above the substrate. When the female was in the cataleptic state typical of the longest copulations, all of her appendages were unextended and motionless and her hind legs and abdomen rested against the substrate.

Four of the nine couplings were lengthy (11-19 minutes), involved palpal insertions, and were distinguished by complete or nearly complete female catalepsy following the onset of coupling. One female participated in three of these long copulations with the same male over a period of seven days. The remainder (five) of the couplings were brief (10-60 s) and were distinguished by the presence of much female struggling (leg movements and cheliceral/fang

extensions) which was probably directly responsible for the brevity of these couplings. Only two of these brief couplings appeared to involve palpal insertions.

During all nine couplings the male extended his pedipalps forwards under the female, and, during the early stages of most couplings, these fully extended but uninserted pedipalps could be seen vibrating rapidly up and down. During one brief coupling that was oriented favourably for pedipalp observation, the pedipalps were vibrated for three brief (2-3 s) closely-spaced bouts, but I could not determine whether they were actually touching the female. Although the mechanical details of palpal insertion were not visible during any of the copulations, it was clear that the palpal organs were inserted alternately and that each insertion was rather brief, lasting somewhere between 5 and 30 s. As one pedipalp was inserted, the other, just disengaged pedipalp, was shifted laterally to the edge of the female's cephalothorax but remained extended. Palpal movements during copulation occasionally were so vigorous that the female's abdomen was visibly jarred.

Usually when the coupled female struggled, and also just before uncoupling, the male would extend his first legs, thereby increasing the distance between himself and the female. Uncoupling involved a sudden pulling back and rapid retreat by the male.

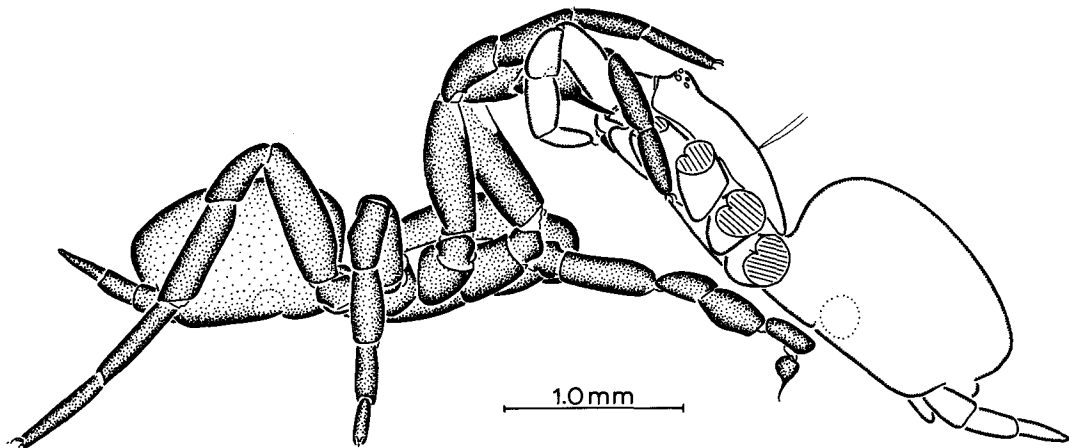


Fig. 2: Lateral view of mating pair of *Microhexura montivaga* drawn from photos, sketches, notes and specimens. See text for description. Since exact orientation of palpal organ and distal articles of male pedipalp were not observed, pedipalp is drawn only to indicate that it was fully extended to the female genital region.

Discussion

In *M. montivaga*, as in some other non-araneomorph spiders (Haupt, 1977, 1979; Minch, 1979; Coyle, in press), contact with the female web is a sufficient stimulus to trigger the male courtship display. The jerking display performed by male *M. montivaga* resembles (and might be homologous to) the jerk-quiver display of *Euagrus* males (Coyle, in press) and the vertical body oscillation of *Australothele jamiesoni* Raven males (Raven, in prep.). Both the front-to-front mating posture and the alternate insertion of palpi have been observed in all non-araneomorph spiders studied. However, the mating of *M. montivaga* is apparently the first case of non-araneomorph mating reported where the female is clasped on her pedipalps rather than on her chelicerae (Buchli, 1962; Coyle, 1971), fangs (Petrunkevitch, 1911; Gerhardt, 1929, 1933; Minch, 1979), second legs (Coyle, in press), or combinations of these and/or first legs (Raven, in prep.).

As is true for *Euagrus* (Coyle, in press) and many other mygalomorph taxa, the two species of *Microhexura* are best distinguished by the form of their male copulatory structures (palpal organs and leg mating claspers) (Coyle, 1981). Several features of the mating behaviour observed in *M. montivaga*, while certainly not demonstrating sexual selection by female choice, might permit such selection to operate on these male mating structures, structures which cannot be sensed by the female until after coupling begins (see Eberhard, in press): (1) The observations that coupling duration seems to be inversely related to the frequency of female struggling and that coupling does not automatically lead to copulation (palpal insertions) suggest that females, during coupling, have some control over whether copulation will occur. (2) The presence of male palpal vibrations after coupling is initiated suggests that during coupling these and other stimuli might help persuade the female to participate in copulation, might induce a post-copulatory process favouring his sperm, or might affect her in other ways that enhance his reproductive success. (3) The willingness of a female to mate more than once might, if she possesses

appropriate sperm take-up and storage mechanisms, increase her opportunity for "comparison shopping" based upon information obtained from males in copula.

Acknowledgements

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