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LEER EN ESPAÑOL

What do we really know about how velvet worms mate?

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ABSTRACT: **After more than a century of studying a phylum that has over 200 species, we only have three reports of the mating itself. Insemination can occur vaginally or through the skin, and it is suspected that the male simply places its genital opening against the vulva and inserts the spermatophore. However, in the particular case of a few Australian onychophorans, males insert it with a specialized head structure, and the spermatophore also serves as a vaginal plug, preventing insemination by other males.**

KEYWORDS: spermatozoa, spermatophore, genital opening, vaginal or skin insemination, fertilization by undesirable males.

Although textbooks confidently describe the "modes of **reproduction** in onychophorans", they fail to mention that only three mating events have been reported, making any generalization unreliable (mating has never been observed in over 200 species).

In Neotropical species, the only report is for a Costa Rican velvet worm, *Principapillatus hitoyensis*, in which female and male join their abdominal ends and the spermatophore enters through the vagina (Oliveira et al., 2012: a brief comment in the supplementary documentation). Supposedly, **spermatozoa** only find space to advance inside the vagina if the female does not have embryos blocking it, so that **mating seems to occur exclusively at the beginning of her life**, and she stores sperm for up to five years. Males of some species have been found with developed spermatophores at four months of age, so they may begin reproduction earlier in life than females (Sherbon & Walker, 2004).

It is assumed that in some southern species (Chile, South Africa and Oceania), males simply place their **genital opening against the vulva** and deposit the spermatophore, but

nobody has seen this. In Australia and New Guinea there are two species that have a penis, and, one can imagine, **vaginal penetration**. In other species, males place **spermatophores** anywhere on the female body, both in South Africa and Australia. It has long been believed that this is as an **adaptation** to embryos obstructing the duct, or ─more probable in our opinion─ a way to overcome vaginal **defenses against forced fertilization by undesirable males**. However, mating has not been seen in any of these species: all we can say is that empty spermatophores have been found attached to the ruptured female skin (Manton, 1938).

In a few Australian species, the male carries a spermatophore in a **specialized head structure**, although it is not known exactly how the spermatophore passes from the genital opening to the head (Tait & Norman, 2001; Monge-Nájera, Barquero-González, & Morera-Brenes, 2019b).

The male uses the head to press the spermatophore into the vagina, and the female helps with her last pair of legs to hold the male attached to her. During the mating, which lasts more than 15 minutes, they can walk together (Figure 1) and the spermatophore serves as a **vaginal plug**, perhaps making it impossible for other males **to inseminate her**. This mating has been seen a couple of times, which are the only additional mating records on the whole phylum (Tait & Norman, 2001; Monge-Nájera et al., 2019a).

FIGURE 1. **Onychophorans mating; drawing by J. Monge-Nájera based on photographs by Tait and Norman (2001).**

An attractive idea, available for over a century, states that males **inseminate vaginally** when there are no embryos, and **through the skin** when embryos obstruct the vagina (Tait & Norman, 2001). However, no author has explained how the male knows that the vagina is obstructed. Does the smell of the female change when the vagina is blocked? Or does she "know" that the passage is blocked, and does not allow the male to introduce the spermatophore vaginally?

In any case, this is a good case for "citizen science". More than ever before, there is a good chance that someone will happen to see a pair of onychophorans mating and will have a camera available to document the process (if you do, please contact julianmonge@gmail.com).

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