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News

X-rated worm movies reveal sex secrets

Sperm design and mating behaviour co-evolve.

Amy Maxmen

Videos of pairs of *Macrostomum* flatworms mating have helped to show how sex shapes sperm.

Still taken from video, courtesy of Lukas Schärer

By watching countless hours of hermaphroditic worm sex, Lukas Schärer and his wife Dita Vizoso, evolutionary biologists at the University of Basel in Switzerland and their colleagues, have discovered evidence for a theory that has eluded testing for nearly a century: sex shapes sperm. Their findings, including videos of the mating worms, are published today in the *Proceedings of the National Academy of Sciences*[1].

Sperm are the most diverse of animal cells, variously adorned with tails, hairs, hooks, bristles and more. "But we don't know what any of those doodads do," says Scott Pitnick, an evolutionary biologist at Syracuse University in New York. Fertilization is not easy to observe, and predictions about the function of sperm design are even harder to test, so it took a group of transparent and rather kinky flatworms to unravel a piece of the puzzle. The creatures are simultaneous hermaphrodites: each has both male and female genitalia. The worms are about the size of a comma, but readily mate under a microscope.

The heterosexual world of animal reproduction is populated primarily by males eager to mate and females more concerned with finding a superior partner, but simultaneous hermaphrodites face antagonistic desires at the same time. Flatworm species in the genus *Macrostomum* solve the conflict by allowing eager sex to come first, and selectivity to follow.

"In the lab they mate like crazy," says Schärer. "Once, we saw a pair mate 40 times in an hour." The flatworms hook up tail-to-tail like two interlocking 'C's, with the penis, or stylet, of each penetrating the female hole of the other and ejaculating into the corresponding cavity, the antrum.

Stylet style

Once the deed is done, selectivity may come into play. The worm bows down and appears to suck the ejaculate of its antrum (see **video**)[2]. "When I saw this for the first time in 2002, I almost fainted," says Schärer. "Since then, we've made mating movies to capture up to 12 pairs simultaneously — I think of it as a naughty hotel with surveillance cameras in every room."

He has found that species that mate reciprocally, and then suck at the female genital opening,

carry ornate sperm with a pair of long bristles emerging at the mid-point and a tail resembling a paint brush. Vizoso says that some *Macrostomum* species have extra sperm appendages, including structures that look like dreadlocks. These decorations can become lodged in tissue within the female orifice after copulation, combating the efforts of the receiving worm to remove the sperm (see **video**).

If hairs and bristles function as mechanisms to avoid sperm being sucked out after sex, the authors hypothesized that flatworms that don't mate with stylet–antrum penetration and subsequent sucking won't have extra appendages on their sperm.

By observing a range of species and assessing their sexuality in the context of the *Macrostomum* evolutionary tree of life, the team deduced that species that engaged in 'traumatic' rather than reciprocal sex have evolved smaller sperm, without hairs or bristles. These species have put an end to mating games: they have stylets shaped more like pirates' hooks than hoses, which they use to stab other worms anywhere in their bodies, and inject the sperm. Once struck, the recipient worm doesn't stoop to suck, and the no-frills sperm quickly makes its way to the egg (see **video**).

"I like this story because it's very unusual for anyone to have any coherent idea about the functional significance of sperm morphology," says William Eberhard, a biologist at the Smithsonian Tropical Research Institute in Costa Rica. "This is one story out of the many, many, many stories we don't understand — it's a first step in the right direction."

References

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2. Schärer, L. *et al. Marine Biology* **145,** 373-380 (2004). | **Article**

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