

Why fruit fly sperm are giant

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Mating *Drosophila* fruit flies. Credit: Image: Stefan Luepold, University of Zurich

In the animal kingdom, sperm usually are considerably smaller than eggs, which means that males can produce far more of them. Large numbers of tiny sperm can increase the probability of successful fertilization, especially when females mate with several males. This is because the competition among sperm from different males to fertilize the few eggs increases as sperm become more abundant. This sperm competition

spurs sexual selection after mating, favoring the best sperm in the female reproductive tract.

Therefore, it is astonishing that [males](#) of certain animal species produce only very few, but gigantic sperm. "The record holder is *Drosophila bifurca*: Although this fruit fly is only a few millimeters long, its sperm reach an impressive length of almost six centimeters," says Stefan Luepold, an evolutionary biologist at the University of Zurich. However, such examples contradict the common understanding of sexual selection because fewer sperm vying to fertilize an egg should relax the selection pressure on sperm to be more successful than their competitors. If only a few sperm are transferred to females as in fruit flies, selection - and thus also the evolution of longer sperm - is expected to be weakened or even halted.

Sexual selection has a major impact on sperm length

A study lead by Stefan Luepold and published in the journal *Nature* now provides the first explanation for the development of such [giant sperm](#). Together with Scott Pitnick and other scientists from Syracuse University and George Washington University in the USA, he managed to demonstrate that sexual selection has a major influence on the evolution of sperm length in fruit flies. The scientists combined experimental, quantitative genetic and comparative studies on sexual traits in various *Drosophila* species.

The study revealed that, on the one hand, different characteristics and processes of sperm uptake, storage and use in the [female reproductive tract](#) favor longer sperm. The longer the sperm become, however, the fewer of them can be produced and transferred. Consequently, females have to mate more frequently to ensure fertilization of their eggs. And each mating creates an opportunity for sexual selection via [sperm competition](#). "In fruit flies, for instance, longer sperm are really good at

displacing their competitors from the female reproductive tract, which gives them an advantage in the competition for fertilization. Sexual selection thus favors longer sperm," explains Stefan Luepold, first author of the study.

Females prefer larger males with more sperm

On the other hand, sperm length is influenced by female preferences prior to mating. Small males can invest less in [sperm production](#) and therefore use up their sperm reserves after only few copulations. Only large, healthy males that are favored by females can afford to produce more sperm despite the increased energetic costs of longer sperm. As a result, only large males benefit from the frequent mating opportunities. Thanks to this increased reproductive success, the genes for longer sperm are able to spread in the population, which ultimately drives the evolution of longer sperm. These complex relationships can maintain, if not intensify, sexual selection even when only very few sperm end up competing for fertilization.

These new findings reveal that the general understanding of [sexual selection](#) needs to be broadened. The evolution of sperm is ultimately based on similar processes as other male sexual traits such as horns to frighten away rivals and ornaments to attract females. "Compared to these and numerous other exaggerated sexual traits, fruit-fly [sperm](#) are probably the most extreme example in the animal kingdom," finds Luepold. In the case of *Drosophila bifurca*, they are around 20 times longer than the male itself and thus transmitted as tightly coiled balls.

More information: Stefan Lüpold et al, How sexual selection can drive the evolution of costly sperm ornamentation, *Nature* (2016). [DOI: 10.1038/nature18005](https://doi.org/10.1038/nature18005)

Provided by University of Zurich

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