Biologists' work with 'glow-in-the-dark' sperm sheds light on sexual selection

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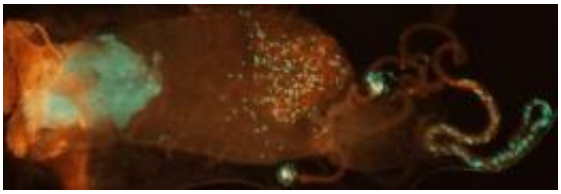

This is the reproductive tract (less ovaries) of female *D. melanogaster* initially mated to GFP-sperm male then remated to RFP-sperm male. Green sperm heads have left the storage organs and can be seen mixing with red sperm heads in the bursa. Credit: Scott Pitnick, Syracuse University

Previously unobservable events occurring between insemination and fertilization are the subject of a groundbreaking new article in *Science* magazine (March 18) by Mollie Manier, John Belote and Scott Pitnick, professors of biology in Syracuse University's College of Arts and Sciences. By genetically altering fruit flies so that the heads of their sperm were fluorescent green or red, Belote and his colleagues were able to observe in striking detail what happens to live sperm inside the female. The findings may have huge implications for the fields of reproductive biology, sexual selection and speciation.

According to Pitnick, many advances in reproductive and evolutionary biology have been constrained by the inability to discriminate competing sperm of different males and by the challenges of observing live sperm

inside the female reproductive tract. The solution? Glow-in-the-dark sperm. "Our first goal with these flies was to tackle the mechanisms underlying sperm competition," says Pitnick. "Whenever a female mates with more than one male—and female promiscuity is more the rule than the exception in nature—there are conflicts between the sexes over paternity, as well as competition between rival ejaculates to fertilize eggs. Such postcopulatory sexual selection is a powerful force for evolutionary change."

Pitnick explains that major advances in reproductive biology came with the advent of molecular tools that determine paternity. "Until now, the door to most of the mechanisms responsible for patterns of paternity has been closed. But not anymore."

By quantifying sperm movement and fate within females inseminated by a green-sperm male and a red-sperm male (including real-time analyses of sperm motility in vivo), Manier and colleagues were able to unambiguously discriminate among hypothesized mechanisms underlying sperm precedence. "Despite nearly a century of intensive and innovative work on the reproductive biology of the fruit fly [*Drosophila melanogaster*], much of what we know about the female reproductive tract is a mystery," continues Pitnick. "Our jaws hit the floor the first time we looked through a microscope and saw these glowing sperm. It turns out that they are constantly on the move within the female's specialized sperm-storage organs and exhibit surprisingly complex behavior."

Pitnick says his team has created similar glowing sperm populations for other species, including ones that hybridize, so he can observe what happens when sperm and the female are evolutionarily mismatched. "I suspect we have just scratched the surface of using this material," he says.

Provided by Syracuse University