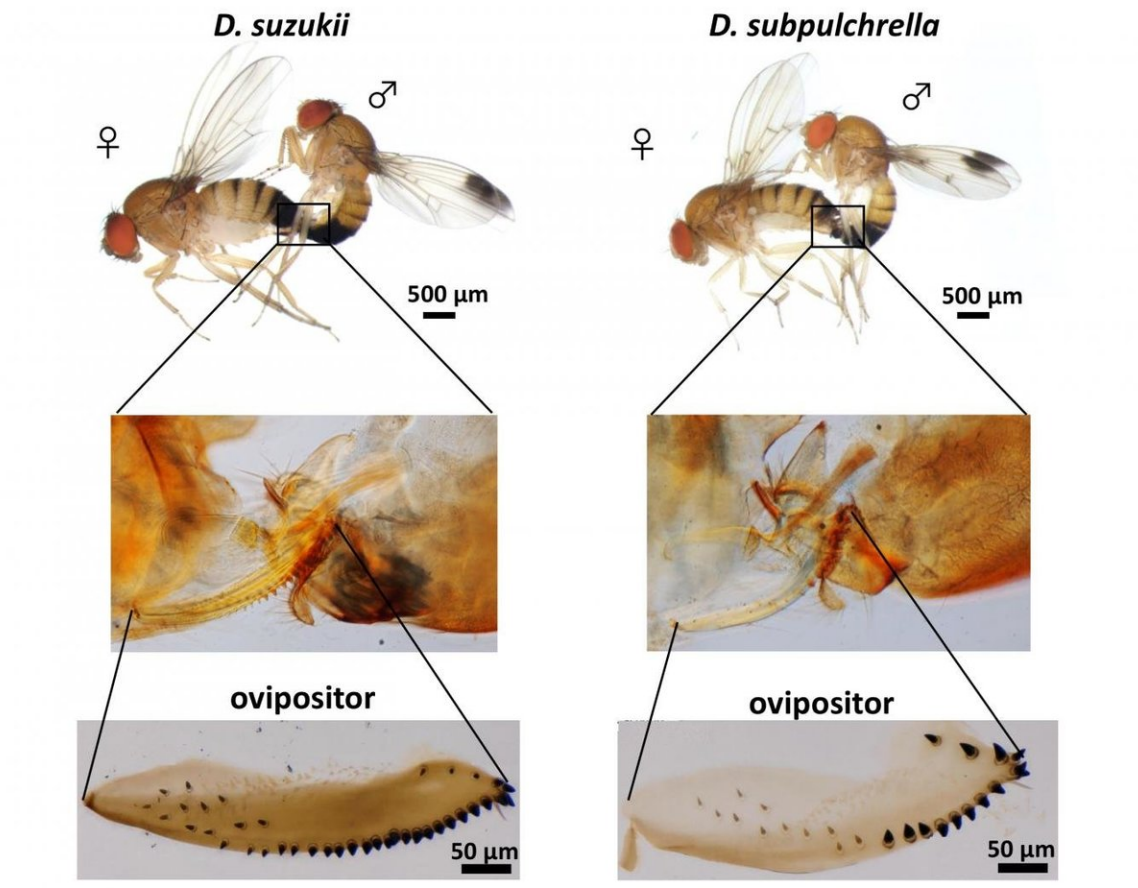
Environmentally-inspired 'niche' features impact species evolution

November 12 2018



The linearly elongated ovipositor of *Drosophila suzukii* has led to changes in genital coupling mechanics during copulation (compared to its sibling species, *D. subpulchrella*). Credit: Aya Takahashi

Researchers from Tokyo Metropolitan University have shown that the environment-driven evolution of a unique ovipositor in the female fruit fly Drosophila suzukii may have caused coevolution of the male genitalia; new features were found to cause mechanical incompatibility during reproduction with similar species, impeding crossbreeding and isolating the species. The dual role of the female genitalia was found to trigger coevolution and speciation, a generic pathway which may apply to many other organisms.

The Drosophila suzukii fruit fly is a fruit-damaging pest. The thin, saw-like serrated ovipositor, the egg-laying organ of the female, allows it to penetrate the hard skin of ripening fruit, unlike most other species of fruit fly which prefer softer, rotting fruit. They are thus a serious problem in invaded areas, now including Europe and America where they have recently been introduced. But a team of researchers from Tokyo Metropolitan University led by Assoc. Prof. Aya Takahashi saw a unique opportunity to study how such ecologically-driven evolutionary traits might affect the coevolution of male and female genitalia. Such a study would help us understand how the specific functions of reproductive organs might influence how different species of organisms develop.

The team found that the unique ovipositor of D. suzukii had benefits for offspring, but required significant changes in the male genitalia to accommodate the obstacle during copulation. By making the cuticle transparent, the team were able to directly confirm that changes to the ovipositor had caused drastic changes in the position in which the flies copulated. This included structural changes in the male genitalia to firmly latch onto the end of the ovipositor without relying on parameres, spikes which help the male fly to latch on during sex. They confirmed that surgical changes to prevent the proper contact of the parameres to female genitalia in sibling species led to a significant decline in reproductive success, whereas D. suzukii were less affected. However,

this did not somehow make them more prone to reproduce. In fact, the new morphology adopted by the male genitalia of D. suzukii made them incompatible with the shorter ovipositors of other fruit flies. This made it more difficult for crossbreeding to occur, effectively isolating D. suzukii and setting them on a different evolutionary track.

It is clear that evolution of the ovipositor was driven by a need to give offspring a better chance of survival in an open niche. However, the team's discoveries show that the dual function it plays, as a means of copulation as well as laying eggs, has caused a feedback to genital coupling mechanics, driving significant changes in the shape and function of the other sexes' genitalia and changing the evolutionary pathway the species follows in the process. Thus, their work provides a rare glimpse into how ecological changes drive the coevolution of male and female genitalia, which may be a more generic mechanism for evolution and speciation in the natural world.

More information: Leona Muto et al, An innovative ovipositor for niche exploitation impacts genital coevolution between sexes in a fruit-damaging Drosophila, *Proceedings of the Royal Society B: Biological Sciences* (2018). DOI: 10.1098/rspb.2018.1635

Provided by Tokyo Metropolitan University