

Flame skimmer dragonfly's splashing oviposition

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The flame skimmer (*Libellula saturata*) is a species of dragonfly native to western North America. A female skimmer has a unique oviposition behavior where it bends its abdomen and skims it through the water surface, flicking water droplets presumably containing its eggs. These droplets land on surrounding aquatic foliage, decreasing the predation on eggs from aquatic predators such as fish. Here, we show the fluid mechanics underlying this ovipositing mechanism. Using a mechanical model system comprising a stepper motor, Arduino, and a 3D-printed model of the dragonfly abdomen, we experimentally simulated the splashing oviposition.

One of the key morphological features that enables splashing could be a flange protrusion near the base of the abdomen. These flanges are often absent in the abdomens of non-splashing dragonflies. Our experimental results show that the flange greatly aids in droplet formation. The flange guides the impact-driven flow to a coherent jet, which subsequently pinches off to a droplet due to Rayleigh-Plateau instability. Furthermore, we show that the droplet formation and travel distance are sensitive to the abdomen submergence depth and impact velocity. This shows that the droplet formation requires a highly coordinated aerodynamic maneuver to create a precise hydrodynamic impact. These results show that the flange, coupled with their strong flight capability, is an effective morphological adaptation that enables unique egg dispersal that ultimately increase the survival of their offspring.