JOHNS HOPKINS
Center for Environmental & Applied Fluid Mechanics

SPRING 2020 SEMINAR

"Bumblebee Wings in the Real World: How Do Flexible, Damage-Prone Airfoils Affect Force Production, Stability, and Maneuverability during Flapping Flight?"

Flying insects such as bees flap their ultra-light wings hundreds of times per second to achieve extraordinary flight performance that we cannot yet replicate in micro aerial vehicles. In addition, flying insects maintain this high level of performance in complex, real-world environments, where they must contend with unpredictable air flows, maneuver through dynamic obstacles, and endure cumulative wing damage resulting from frequent collisions. Despite intensive research on the kinematic and aerodynamic mechanisms that insects employ during flight, our understanding of one fundamental aspect of flapping flight - the airfoils themselves - lags far behind. Insect wings bend and twist passively during flight, and their complex structural design reflects 400 million of years of adaptive evolution. I will discuss my lab's ongoing research investigating the effects of insect wing flexibility on multiple aspects of flight performance, including maximum force production, maneuverability and stability, through experimental manipulations of wing stiffness in live bees. I will also discuss how collisions lead to cumulative wing damage, and describe our research investigating how flexible wing design helps mitigate wing damage, and how asymmetric vs. symmetric damage affects acceleration capacity, stability, and maneuverability during flight.

Stacey A. Combes

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Stacey Combes received her B.A. in Integrative Biology from U.C. Berkeley and completed her Ph.D. on insect wing flexibility and passive bending during flapping flight in 2002 at the University of Washington. She returned to U.C. Berkeley as a Miller Fellow, conducting fieldwork in Panama on environmental turbulence and stability during forward flight in wild orchid bees. Stacey joined the faculty of the Organismic and Evolutionary Biology Department at Harvard in 2008 and moved to the Department of Neurobiology, Physiology and Behavior at the University of California, Davis in 2015. She received an NSF CAREER award in 2013 and was named a U.C. Davis Chancellor's Fellow in 2019. Research in the Combes Lab explores the biomechanics and behavioral ecology of flying insects. Current projects investigate topics such as the effects of spanwise vs. chordwise flexibility on dynamic wing bending and flapping flight performance, effects of pesticides and barometric pressure on foraging activity in bumblebees, and effects of climate change on dragonfly flight performance during aerial predator-prey interactions.

Friday, January 31, 2020

3:00 PM, Hodson Hall 213