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A wake-based correlate of swimming performance in seven jellyfish species JOHN DABIRI, California Institute of Technology, SEAN COLIN, Roger Williams University, KAKANI KATIJA, California Institute of Technology, JOHN COSTELLO, Providence College — Animal-fluid interactions have been hypothesized as a principal selective pressure on the evolution of aquatic and aerial animals. However, attempts to discover the fluid dynamic mechanisms that dictate the fitness of an animal—or even to quantify 'fitness'—have been limited by an inability to measure the fluid interactions of freely moving animals (i.e., in the absence of tethers or artificial water/wind currents) in comparative studies of multiple species with similar evolutionary histories. We used digital particle image velocimetry (DPIV) measurements to calculate wake kinetic energy, drag, and swimming speed of the seven co-occurring species of free-swimming jellyfish. Using this new data, we demonstrate that the swimming and foraging behavior are related to a robust fluid dynamic threshold between two distinct configurations of the wake vortices. The transition between the two wake vortex configurations is known as optimal vortex formation, because it maximizes the fluid dynamic thrust generated for a given energy input (Krueger and Gharib, Phys. Fluids 2003). By comparing the observed wake structures created by each jellyfish species with the optimal vortex configuration, we are able to predict their relative swimming efficiencies and proficiencies and to deduce their corresponding ecological niches.

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