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Sea Stars Generate Downforce to Stay Attached to Surfaces[1]
MARK HERMES, University of Southern California — Intertidal sea stars often function in environments with extreme hydrodynamic loads that can compromise their ability to remain attached to—and move on—surfaces. While behavioral responses such as burrowing into sand or sheltering in rock crevices can help minimize hydrodynamic loads, previous work shows that sea stars also alter body shape in response to flow conditions. This morphological plasticity suggests that sea star body shape and size may play an important hydrodynamic role. Here, we show through laboratory water channel experiments that pentaradial sea stars generate downforce rather than lift. This downforce is created because the sea star bodies serve as pronounced ramps that divert fluid away from the surface. The hydrodynamic forces generated by surface-mounted bodies like hemispheres, cylinders, pyramids, and cubes have been characterized in many prior studies. However, none of these studies report downforce generation. The discovery of downforce generation may explain why sea stars are shaped as they are: the pentaradial geometry can aid adhesion to the surface in the presence of high hydrodynamic loads. Further, the morphological plasticity observed in nature could be attributed to the need for increased downforce in wave-exposed locations.

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