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Crucial advantages of tail use in the evolution of vertebrate terrestrial locomotion. HENRY ASTLEY, Georgia Inst of Tech, BENJAMIN MCINROE, U C Berkeley, SANDY KAWANO, National Institute for Mathematical and Biological Synthesis, RICK BLOB, Clemson University, DANIEL GOLDMAN, Georgia Inst of Tech — In the invasion of terrestrial environment, the first tetrapods faced the challenge of locomotion on flowable substrates (e.g. sand and mud), sometimes oriented at inclines. Although the morphology of many early tetrapods is known, robotic studies have revealed that effective locomotion on these substrates also depends strongly upon kinematics; slight differences in movements of the same appendage can lead to success or failure. Using a model organism (the mudskipper) and a robotic physical model, we demonstrate how muscular tails provided critical locomotor advantages on granular substrates that the first invaders of land likely encountered. Mudskippers use their tails for additional propulsion with increasing frequency as the slope of the granular material increases, and the decline in locomotor performance with slope is shallower when the tail is used. Experiments with a robotic model of the mudskipper showed that, while the tail did not always provide a benefit to locomotion, use of the tail made the robot's performance more robust, achieving effective locomotion on a wider range of slopes, limb postures and foot placements. These results suggest that, rather than simply being an inert appendage, the tails of early tetrapods were vital to their first forays into terrestrial habitats.

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