Applying Biological Models To Understand How Vertebrate Animals Moved Onto Land

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Transitions to novel habitats present different adaptive challenges, producing captivating examples of how functional innovations of the musculoskeletal system influence phenotypic divergence and adaptive radiations. One intriguing example is the transition from aquatic fishes with fins to tetrapods with limbs. Recent technological advances and discoveries of critical fossils have catapulted our understanding on how fishes gave rise to terrestrial tetrapods. Over the past several years, I have used living fish and salamanders as biological models to gain perspective on different aspects regarding the functional evolution of terrestrial locomotion in vertebrate animals. These biological models resemble important fossil fishes and early tetrapods due to morphological and ecological similarities. Biomechanical analyses have demonstrated a shift in how these animals support their body weight on land as one moves from aquatic fish to terrestrial salamanders, which could have influenced the stresses that were experienced by their bones. I then used a mathematical model based on muscle anatomy and biomechanical principles to determine different functions of the forelimbs and hind limbs of a terrestrial salamander, providing insight into the acquisition of novel locomotor capabilities as tetrapods became terrestrial. At the conclusion of the talk, I discuss how these data can be applied to computationally model the biology of fossil stem tetrapods.

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