Exploring the functional meaning of head shape disparity in aquatic snakes.

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Abstract

Phenotypic diversity, or disparity, can be explained by simple genetic drift or, if functional constraints are strong, by selection for ecologically relevant phenotypes. We here studied phenotypic disparity in head shape in aquatic snakes. We investigated whether conflicting selective pressures related to different functions have driven shape diversity and explore whether similar phenotypes may give rise to the same functional output (i.e. many-to-one mapping of form to function). We focused on the head shape of aquatically foraging snakes as they fulfil several fitness-relevant functions and show a large amount of morphological variability. We used 3D surface scanning and 3D geometric-morphometrics to compare the head shape of 62 species in a phylogenetic context. We first tested whether diet specialization and size are drivers of head shape diversification. Next, we tested for many-to-one mapping by comparing the hydrodynamic efficiency of head shapes characteristic of the main axis of variation in the dataset. We 3D printed these shapes and measured the forces at play during a frontal strike. Our results show that diet and size explain only a small amount of shape variation. Shapes did not functionally converge as more specialized aquatic species evolved a more efficient head shape than others. The shape disparity observed could thus reflect a process of niche specialization under a stabilizing selective regime.

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