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Digest: Old world climates give rise to "young" lizard skulls*

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Shared environmental pressures often give rise to the convergence of morphological characters in unrelated and geographically distinct species. Darwin (1859) wrote that "analogous variation" of traits in different organisms could be explained by similar influences or challenges in their environment. Convergence of traits can be driven by adaptive radiation when animals invade similar ecological feeding niches and consequently converge on similar morphologies, such as broader beak shape in seed-crushing species of Darwin's finches (Grant, 1999). Climate can also be a factor, as demonstrated by morphological convergence of rodents from distinct arid habitats in the Sonoran (SW United States) and Monte (NW Argentina; Mares, 1976) Deserts. Observed patterns of ecomorphology suggest that overall body size decreases with warmer climates (Bergmann's Rule), while limb length increases (Allen's Rule; Schreider, 1951). Despite clear evidence of a relationship between morphology and environment, the mechanisms underlying trait convergence are not always clear.

Until recently, it has been difficult to determine if convergent evolution occurs as a result of adaptations to a particular habitat, or if trait evolution is constrained by developmental mechanisms. In this issue, Hipsley and Müller (2017) address this fundamental biological question by investigating ecomorphological convergence in skull shape within a broad family of lacertid lizards that span across Eurasia and Africa, inhabiting vastly different climates over their distribution.

Using landmark-based geometric morphometrics, Hipsley and Müller (2017) compared derived lizards adapted for dry climates to their basal ancestors that inhabited moderately moist ("mesic") habitats. Desert-dwelling species' skull shape was significantly different from that of lizard species in other habitats. The authors noted variation in the shape of the eye socket, the length of the snout, and the depth of the cranium across lacertid lizards from different ecoregions.

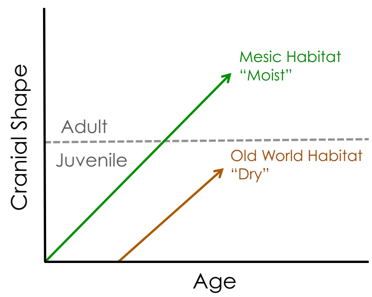

Figure 1. Proposed growth trajectory across life history for lacertid lizards. The normal trajectory from juvenile to adult occurs for lizard species inhabiting mesic, or moderately moist habitats (green). Postdisplacement during growth may result in paedomorphic, or juvenile-like skulls in lizards from Old World habitats (brown). Figure adapted from Hipsley and Müller 2017.

Interestingly, desert-dwelling lizards exhibit "young" (or juvenile-like) skulls as adults—with large orbits and nares (Fig. 1). This phenomenon, known as paedomorphosis, describes the retention of juvenile characteristics in adult morphology (Wiens et al. 2005). Paedomorphosis is not unique to the transcontinental Lacertidae, however. Certain salamander species retain whole-body larval traits by failing to complete metamorphosis as an adaptation for life in aquatic habitats (Wiens et al. 2005). Desert-dwelling lizards, like paedomorphic salamanders, may regulate their growth trajectory in response to their extreme environment.

This natural example of convergence links morphology closely with ecological habitat and demonstrates an ability to delay skull development in response to environmental challenges.

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The question of whether adaptation or developmental constraint contributes to phenotypic convergence is complex, especially because the genetic and developmental mechanisms underlying the formation of the skull in lacertid lizards remain poorly understood. Hipsley and Müller (2017) argue that both adaptation to the arid environment and flexibility during development influence the convergence of juvenile-like skulls in Old World lizards.

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