Progenesis: reaching adulthood earlier and at a smaller body size as a way to exploit underused resources

Plain language photograph legend: As a consequence of earlier sexual maturity, progenetic palmate newts (*Lissotriton helveticus*) are significantly smaller than normally developing adults and retain larval traits such as external gills.
Photo credit: Mathieu Denoël.

Progenesis is a developmental process that speeds up sexual development, and consequently maturity, therefore associated with a smaller body size. Despite being a major evolutionary process throughout the animal kingdom, there is a lack of studies on its ecological consequences. Previous research mainly focused on better fitness through precocious reproduction or advantages of getting smaller in specific environmental contexts, such as parasitism or life in interstitial habitats. Yet, body size is also a key factor determining an animal's trophic niche and its change can potentially allow resource exploitation in a novel way. Therefore, we formulated 'the trophic advantage of progenesis' hypothesis, which predicts that progenesis might intrinsically promote trophic niche differentiation via body size reduction.

We tested our hypothesis in facultatively progenetic populations of a European amphibian, the palmate newt (*Lissotriton helveticus*). These populations have the advantage of being composed of alternative phenotypes that either develop normally through metamorphosis (metamorphs) or mature early and at smaller body size while retaining larval gills (progenetics). To this end, we assessed trophic niche use of both phenotypes using stable isotopes (an integrative marker of assimilated diet) and stomach content analyses, while also assessing their body condition (a measure of seasonal fitness) and accounting for habitat heterogeneity and prey diversity across ponds.

We found that not only did progenetic individuals occupy a different trophic niche than the metamorphic phenotype in all populations, but the smaller they were compared to metamorphs, the more different they were in terms of trophic ecology, without impacting their body condition. Our results suggest that via body size reduction, progenesis may generally act as an intrinsic factor of ecological opportunity, allowing the use of existing but previously unavailable resources, even in habitats where seemingly little opportunity exists, such as shallow ponds.

We argue that beyond the generally recognized fitness advantages of progenesis such as an earlier reproduction, this process may also generally bring immediate trophic advantages via body size reduction which would have important implications to understand the evolution and adaptiveness of this process throughout the animal kingdom.

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