Why do organisms produce morphologically
different offspring at the same time?

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ABSTRACT: Offspring heteromorphism is a reproductive strategy in which species simultaneously produce offspring that differ in morphology. It occurs across the Tree of Life but is particularly common among plants, where it is termed seed heteromorphism. The prevalence of this strategy in unpredictable environments such as deserts has resulted in the assumption that it serves as a bet hedging strategy. We reviewed the diversity of this life history strategy in the southwestern North America and statistically evaluated its association with arid habitats. We then focused on one seed heteromorphic species, Pectocarya heterocarpa, and conducted field and greenhouse studies. Specifically, we examined the change in the ratio of the different seed morphs across an aridity gradient and investigated the fitness consequences of the different seed morphs across different levels of water availability in the greenhouse. In our large-scale analysis we found that seed heteromorphic species tend to be associated with arid habitats. In our detailed investigation of P. heterocarpa we found that differences in germination and growth characteristics of different seed morphs directly translate to different fitness outcomes. Specifically, basal seeds are better in very arid conditions and aerial seeds better in less arid conditions. Most interestingly, the ratio of seed morphs across our aridity gradient varied in accordance to our findings in our greenhouse study. Our work provides a rigorous assessment of the underlying mechanism of offspring heteromorphism. This mechanism allows species to cope with unpredictably changing environments and our understanding of it is crucial to gaining predictive power for population dynamics amidst global climate change and the increasing desertification associated with it.