Cumulative Adversity Index: A Framework to Investigate the Effect of Multiple Stressors in Natural Populations

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Abstract

Early life experiences have a disproportionate impact on individuals' fitness, but most research has focused on the effects of single experiences, or stressors, often under controlled conditions. Protecting natural populations that must contend with co-occurring stressors requires a better understanding of how multiple early-life stressors affect the health and ecology of natural systems. However, the complexity of such research has limited its advancement. To address this challenge, human studies adopted cumulative risk models that predict adult health risk based on early adversity exposure. We propose a novel framework on how to adapt such models to assess the health and ecology of natural populations. In this framework we detail how and when to develop various types of cumulative early adversity (CEA) indices for wild populations. We then use a case study to demonstrate that such indices can predict pup survival and adult longevity in a wild population of yellow-bellied marmots (Marmota flaviventer). Our results highlight that CEA indices yield unique insights and improve model fit. With this framework we hope to spur further investigations on the impact of cumulative adversity in natural systems, which is critical to inform conservation and management in the Anthropocene.

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