Animal behavior, fitness, demography, and ultimately, distributions are shaped to varying extents by climatic conditions. While we understand the mechanisms underlying endotherm responses to temperature variation, we know little regarding the ways that variation in rain influences them via direct and/or indirect processes. I developed a framework for predicting when and where rain will matter to birds and other endotherms and tested that framework in two systems—tropical birds living in extremely wet environments, and birds breeding in mid-continental grasslands where rainfall variability shapes many ecological processes. In tropical manakins, multiple lines of evidence point to both geographic areas and years of higher relative rainfall imposing direct survival costs in ways that constrain the scope for sexual selection. In local grasslands, while short-term variation in rainfall does directly influence reproduction and adult condition, the consequences of rain on demography primarily act via lagged, vegetation-mediated dispersal decisions. Insights from an integrated population model based on 10 years of intensive field studies reveal that local abundance is primarily shaped by that climate-dependent movement in and out of the local region. In both tropical and temperate systems, this work paves the way for new work involving direct measures of local dispersal and experimental manipulations of rainfall in the tropics. Insights from this research are crucial to understanding and predicting the consequences of changing climates.

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