Research Summary:

The Effects of Climate Change on the Elevational Distributions of Bird Species in Southern California

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The biogeographical distribution of a species is generally limited to the set of environmental conditions or ecological "niche" to which the species is best adapted, including climate and habitat. Distribution limits often occur at well-defined points along ecological gradients, and these points may shift over time. If environmental conditions change, then populations at distribution margins should show evidence of expansion or contraction in association with that change. For example, increasing temperature at the cooler distribution margins of a desert-adapted species should enhance survival and reproduction, causing expansion. Despite the ecological and evolutionary significance of distribution boundaries, populations have rarely been studied at distribution margins, and thus boundary processes and dynamics are poorly understood. We are now faced with the urgent challenge of learning how distributions may shift in response to climate change.

My goal is to elucidate the nature of distribution limits by studying species-habitat relationships and their response to climate change along an ecologically "steep" gradient, that is, a gradient encompassing a wide range of environmental conditions over a relatively short geographical space. I am investigating the causes and consequences of bird distribution limits along an arid elevation gradient in southern California that is undergoing rapid climate change. Through the use of historical data collected 25 and 100 years ago at sites along the gradient between the Colorado Desert and Peninsular Mountains, and extensive current surveys including the same sites, the comparative structure and dynamics of breeding distributions among bird species will be related to environmental factors. Temperature and aridity are expected to increase in this system, and thus, distributions of species are expected to shift upward in elevation.

Set within this large-scale distribution context, I will test for local-scale differences in breeding performance at distribution margins. Territory and nest-level monitoring will be performed on two species with overlapping breeding distribution limits at the transition zone: Black-chinned Sparrows (*Spizella atrogularis*), whose peak abundance occurs in higher elevation chaparral, and Black-throated Sparrows (*Amphispiza bilineata*), whose peak abundance occurs in lower elevation desert scrub. Breeding constraints will be determined by comparing the relative breeding success and habitat associations of territories in peripheral locations to more central locations. The roles of environmental constraints will be investigated, including weather, food availability, and predation. If the distributions of these two species are shifting upward in elevation, as predicted by climate change, then breeding success should be reduced at lower elevations relative to higher elevations.

My preliminary results are remarkable. Over the past 25 years, five species (out of 26 tested) showed statistically significant distribution shifts, all upward in elevation. Likewise, there has been an upward elevational shift in the avian community as a whole. Locally, mean maximum temperature in the desert has increased by 4.0°C since 1961. These results suggest very rapid shifts in association with climate change, which would have profound implications for this arid ecosystem.