Body size response to climate and net primary production: testing the explanatory power of environmental anomalies in temperate songbirds

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Abstract

Body size decline has been proposed as the third universal response to climate warming, but empirical evidence is controversial. It is not clear whether the mechanisms underlying body size variation are directly related to changes in ambient temperature, or rather to subsequent changes in food availability. Based on long term biometric data (15 years, 257 sites), we examined the relationship between juvenile biometric measurements (wing length, n = 40 493; body mass, n = 28 823) and local anomalies in temperature, temperature variability, precipitation and net primary production (NDVI) for 41 songbird species in France. Body size did not change through time for most species, and when it did, birds generally became larger. Juvenile birds had slightly larger wings in years with locally high net primary production and/or temperatures (accounting for 7.6% of temporal variation). Body mass was higher in wet years, particularly in species foraging on soil invertebrates or breeding more than once a year (accounting for 20% of temporal variation). In temperate songbirds, body size fluctuations are better explained by climate-driven fluctuations in food availability for juvenile growth. We argue that global warming-induced reduction of body size may be restricted to tropical organisms, operating close from their thermal maximum. These results invalidate the universality of Bergmann's rule applied to climate warming, suggesting that the development of songbirds is not constrained by high temperatures in temperate climate. Despite significant effects, simple and widely used climatic variables explained a limited part of interannual fluctuations in body constitution at the macroecological scale.

Keywords: body mass, wing length, precipitation, temperature, NDVI, food availability, juvenile, citizen science, France, Bergmann's rule

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