From individuals to populations: intraspecific competition breaks the temperature-size rule

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Abstract

The adult size of most ectotherms follows the so-called temperature-size rule. Body lengths of individuals can also be plastically modified by density. In turn, density dependence may be modulated by temperature. Our aim is to disentangle the effects of temperature, density dependence and their interaction on body length. Using the Collembola *Folsomia candida*, we describe the reaction norms of maturation length, growth rate and asymptotic size over a large temperature range (11 to 26∘C) measured on isolated individuals. In parallel, we examine the structure and dynamics of populations reared under the same temperatures. We then use the reaction norms measured on isolated individuals to predict variation of mean asymptotic adult size and mean growth rates measured in the populations. We find that the body length of isolated individuals follows the temperature-size rule. The population dynamics and population size structure also depend on temperature, but density dependent effects overrule individual-level reaction norms. At high temperature, the collembola reach a higher body size while the population density decreases, which may result from a more intense interference competition between individuals. By providing a quantitative analysis of the way growth rates and asymptotic size change according to temperature and density in a population context, we stress the need to untangle the complex interactions between environment and demography to help in predicting how climate change influences population dynamics.

Keywords: Collembola, Density, dependence, Body length, Demography, Population dynamic, temperature, competition, temperature, size rule

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