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Extrapolating Population-level Impacts of Environmental Transformation

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The environment affects the physiology and development of individuals, but its impacts on traits like growth, reproduction and survival will ultimately cascade into population-level demographic effects. This chapter will focus on using environmental physiology to understand and predict population level consequences of environmental change. I will start by discussing the ways that environmental effects on physiology might translate into changes in key demographic parameters through changes in metabolic rate and survival. I will then discuss the concept of the abiotic niche, and how this concept can be used to understand the demographic consequences of environmental change, including changes in local population size, and shifts in geographic range. I will discuss methods for estimating abiotic niche breadth, including environmental niche modeling, physiological trait-based methods, and the limitations of each approach. Finally, I will discuss plastic responses to environmental change and the population level consequence of phenotypic plasticity. Plasticity may buffer populations from the demographic effects of environmental change, and may also lead to altered species’ interactions. For example differing levels of phenological plasticity between interacting species may result in mismatched seasonal timing as the climate warms. Taken together, all of these approaches to understanding the physiological roots of demographic responses will improve our ability to understand and anticipate the responses of sensitive populations to environmental change.