Changes in (a)biotic drivers of the demography of a forest herb species will lead to changes in its Nordic distribution.

Drivers of large-scale spatial demographic variation in a perennial plant

ABSTRACT

Population growth is determined by the survival, growth and reproduction of individuals, which in turn are affected by environmental conditions. To fully understand how the environment drives spatial variation in population dynamics, we need to assess the effects of a large number of potential drivers on the vital rates (survival, growth and reproduction), and explore these relationships over large geographical areas and long environmental gradients. In this study, we examined the effects of a broad variety of biotic (including intraspecific density) and abiotic environmental factors on the demography of the forest understory herb *Actaea spicata*, between 2017 and 2019 at 40 sites, including the northern range margin of its distribution. We assessed the effect of potential environmental drivers on vital rates using generalized linear mixed models (GLMMs), and then quantified the impact of each important driver on population growth rate (λ) using integral projection models (IPMs). Population dynamics of *A. spicata* were mostly driven by environmental factors affecting survival and growth, such as air humidity, soil depth and forest tree species composition, and thus those drivers jointly determined the realized niche of the species. Even though pH had a strong effect on the flowering probability, the effect on population growth rate was relatively small. In addition to identifying specific drivers for *A. spicata's* population dynamics, our study illustrates the impact that spatial variation in environmental conditions can have on λ. Assessing the effects of broad range of potential drivers, as done in this study, is important not only to quantify the relative importance of different drivers for population dynamics but also to understand differences in species abundance and distribution.

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