**Discussion**

In this paper, we build off of recent empirical work identifying the presence of parallel urban-rural clines in the frequency of hydrogen cyanide (HCN) across eastern North American cities (Thompson et al. 2016; Johnson et al. 2018, *this issue*). We used spatially-explicit, agent-based simulations to test the hypothesis that parallel clines in non-additive traits—of which HCN is an example—can arise due to gradients in the strength of genetic drift. We found that independent of how drift is manipulated (e.g. through serial founder events or a gradient in maximum population size), drift lead overwhelmingly to the formation of positive clines and steeper drift gradients generated more strongly positive clines, although these effects decreased with increasing migration. However, clines formed by drift alone were substantially weaker than those generated by selection, suggesting an upper limit to the strength of phenotypic clines in non-additive traits due to drift. Finally, when selection operated counter to the prevailing drift gradient, stronger selection was required to generate clines as strong as those observed in the absence of drift. Below, we begin by discussing the relevance of our results for the evolution of cyanogenesis clines in white clover. We then suggest that urban environments—in combination with knowledge of the genetic architecture of focal traits—can provide the replication necessary for understanding the contributions of drift, selection, and gene flow to the evolution of clines in non-additive traits. We end by more broadly discussing the role of various evolutionary mechanisms in the formation of phenotypic clines.

*Evolution of cyanogenesis clines in Trifolium*

Understanding geographical variation in allele and phenotype frequencies often provides insight into the evolutionary mechanisms structuring patterns of genetic variation in natural populations. In white clover, pioneering work by Hunor Daday identified broad-scale latitudinal clines in the frequency of HCN across multiple continents (Daday 1954a, 1958) and altitudinal clines across the central European Alps (Daday 1954b). This work has since been extended and clines in the frequency of HCN appear quite common, with higher frequencies occurring in warmer and drier habitats (de Araújo 1976; Ganders 1990; Kooyers and Olsen 2012, 2013; Kooyers et al. 2014; Thompson et al. 2016). These patterns are thought to reflect the benefits of producing HCN in warmer environments where herbivores are more common, the cost of producing HCN in frost-prone habitats, and the benefits of producing cyanogenic glycosides in regions subject to moderate drought stress (Daday 1965; Kakes 1989; Kooyers and Olsen 2013; Kooyers et al. 2014). Thus, investigations into the mechanisms structuring spatial variation in HCN frequencies have focused largely on selection (but see Kooyers and Olsen 2012; Johnson et al. 2018, *this issue*), despite the genetic architecture of HCN making populations particularly susceptible to loss of HCN via drift.