Limited dispersal speeds up adaptation via non-additive genetic variants

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Abstract.

The probability and the expected time for new beneficial alleles to fix via selective sweeps are two relevant quantities in population genetics. Such sweeps may be hard – where the fixing allele originates from a new mutation – or soft, in which the fixing allele comes from the species' pool of standing variation. The mean time taken by these different sweeps is well understood in well-mixed populations where individuals interact and compete randomly. Many natural populations, however, are subdivided and dispersal-limited. While such dispersal limitation is known to influence the probability that non-additive beneficial alleles will fix, its effect on the time taken by such fixation remains understudied. Here we show how limited dispersal and population subdivision affect the time scale of adaptation via hard and soft sweeps. We find that dispersal limitation always increases the time taken by an additive allele to sweep. In contrast, for sweeps of non-additive alleles, we find non-monotonic effects of dispersal limitation on the rate of adaptation: it decreases the time an allele takes to fix as dispersal is initially limited, but rises the time of sweeps if it is further limited past below a dispersal threshold. Regarding soft sweeps, we find that adaptation of recessive alleles no longer benefits from dispersal limitation. Overall, adaptation is faster under realistic dispersal rates when mutations have non-additive fitness effects. This work puts forward our understanding of the pace of genetic adaptation under the influence of limited dispersal, population structure and genetic dominance – in particular for non-additive alleles.