

Migration in Times of Uncertainty

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Abstract : Understanding the effect of fluctuations on populations is crucial in the context of increasing habitat fragmentation, climate change, and biological invasions, among others. Migration in response to environmental disturbances enables populations to escape unfavorable conditions, benefit from new environments and thereby ride out fluctuations in variable environments. Would populations disperse if there is no uncertainty? Karlin showed in 1982 that when sub-populations experience distinct but fixed growth rates at different sites, greater mixing of populations will lower the overall growth rate relative to the most favorable site. Here we ask if and when environmental variability favors migration over no-migration. Specifically, in random environments, would a small amount of migration increase the overall long-run growth rate relative to the zero migration case? We use analysis and simulations to show how long-run growth rate changes with migration rate. Our results show that when fitness (dis)advantages fluctuate over time across sites, migration may allow populations to benefit from variability. When there is one best site with highest growth rate, the effect of migration on long-run growth rate depends on the difference in expected growth between sites, scaled by the variance of the difference. When variance is large, there is a substantial probability of an inferior site experiencing higher growth rate than its average. Thus, a high variance can compensate for a difference in average growth rates between sites. Positive correlations in growth rates across sites favor less migration. With multiple sites and large fluctuations, the length of shortest cycle (excursion) from the best site (on average) matters, and we explore the interplay between excursion length, average differences between sites and the size of fluctuations. Our findings have implications for conservation biology: even when there are superior sites in a sea of poor habitats, variability and habitat quality across space may be key to determining the importance of migration.

Keywords : migration, variable-environments, random, dispersal, fluctuations, habitat-quality

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