Analyzing landscape impacts on effective dispersal

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Abstract

The spatial and temporal heterogeneity of landscapes can tremendously influence organismal movement and resulting gene flow patterns, sometimes referred to as 'effective dispersal'. To understand landscape influences on effective dispersal, two different data types need to be obtained and linked: the first describing movement or gene flow, the other capturing landscape heterogeneity from the perspective of the study species. Here, I provide an overview of the different approaches available for gathering and statistically linking these two types of information. First, to investigate dispersal, direct observations, mark-recapture, telemetry or genetic approaches can be used. Genetic data are most valuable to detect dispersal movements that actually led to genetic exchange among locations, while telemetry data can deliver the most detailed information on individual movement paths. Hence, I provide a summary of novel genetic methods for estimating recent migration rates and for identifying individual migrants, and also suggest a conceptual framework for path-level analysis of movement tracks. Second, resistance surfaces are often modelled to quantify landscape heterogeneity. These surfaces attempt to capture the effects of the landscape in-between locations on movement and gene flow, thereby focusing on the transience phase of dispersal. However, emi- and immigration are also affected by local environmental conditions, and these effects can be incorporated into landscape genetic analyses. Finally, I present an empirical case study that combines individual movement data with resistance surface modelling and landscape genetics to illustrate the advantages of combining different data types and analytical approaches for understanding landscape impacts on effective dispersal.

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