

Demography, Dispersal, and Invasion Wave Speed: a Multi-Species Analysis

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Our understanding of demography has improved tremendously over the past 50 years. So has our understanding of dispersal and its effects. However, our understanding of how demography and dispersal interact to determine spatiotemporal population dynamics is relatively poor. Recent theoretical advances are beginning to bridge this gap, but because demographic and dispersal data are rarely presented together, they have seldom been applied. To remedy this, we formed a working group of empirical ecologists who had both demographic and dispersal data and theoreticians interested in these processes. Together, we analyzed approximately 140 data sets on birds, mammals and plants.

We organized our analyses around the integrodifference matrix population model described by Neubert and Caswell [1],

$$\mathbf{n}(x, t + 1) = \int_{-\infty}^{\infty} [\mathbf{K}(x - y) \circ \mathbf{A}] \mathbf{n}(t, y) dy. \quad (1)$$

In this model, the elements of \mathbf{n} give the spatial population density of the various stages in the life cycle and the matrix \mathbf{A} contains the rates of the demographic transitions. The dispersal distribution of an individual making the transition from state j to state i is given by the ij entry in the

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matrix \mathbf{K} . We used this model to calculate invasion wave speed and other attributes of invasion waves as statistics that integrate both demography and dispersal. In this talk, we present our results, among which are:

1. The discovery of a strong correlation between the sensitivity of invasion speed to changes in demographic parameters and the sensitivity of population growth rate to those same changes.
2. The agreement (or lack thereof) between projected and observed invasion speeds depends on the scales at which dispersal and invasion are measured. The agreement is, in general, good for birds and mammals, but poor for plants.
3. When viewed across a wide taxonomic range, there are strong correlations among dispersal characteristics, demographic characteristics and attributes of invasions.

The NCEAS Working Group on Demography and Dispersal includes: James Bullock, Brian Beckage, Hal Caswell, James Clark, Claudio DiBacco, Gordon Fox, Janneke HilleRisLambers, Carol Horvitz, Susan Kaliz, Rob Lensink, Mark Lewis, Michael Neubert, Ingrid Parker, William Platt, and Katriona Shea.

References

- [1] Neubert, M. G. & H. Caswell. 2000. Demography and dispersal: calculation and sensitivity analysis of invasion speed for structured population models. *Ecology* 81:1613-1628.