www.elsevier.com/locate/yjtbi

Locally Dispersing Populations in Heterogeneous Dynamic Landscapes with Spatiotemporal Correlations. I. Block Disturbance

David E. Hiebeler, Jennifer Houle, Frank Drummond, Peter Bilodeau, Jeffery Merckens

PII: S0022-5193(16)30215-6
DOI: http://dx.doi.org/10.1016/j.jtbi.2016.07.031
Reference: YJTBI8756

To appear in: *Journal of Theoretical Biology*

Received date: 20 January 2016
Revised date: 7 July 2016
Accepted date: 20 July 2016

Cite this article as: David E. Hiebeler, Jennifer Houle, Frank Drummond, Pete Bilodeau and Jeffery Merckens, Locally Dispersing Populations i Heterogeneous Dynamic Landscapes with Spatiotemporal Correlations. I. Bloc Disturbance, *Journal of Theoretical Biology* http://dx.doi.org/10.1016/j.jtbi.2016.07.031

Locally Dispersing Populations in Heterogeneous Dynamic Landscapes with Spatiotemporal Correlations. I. Block Disturbance

David E. Hiebeler[a,*], Jennifer Houle[a], Frank Drummond[b], Peter Bilodeau[a], Jeffery Merckens[a]

[a] *Department of Mathematics and Statistics, University of Maine, Orono, ME 04469*
[b] *School of Biology and Ecology, 305 Deering Hall, University of Maine, Orono, ME 04469*

Abstract

Locally dispersing populations are generally favorably affected by increasing the scale of habitat heterogeneity because they can exploit contiguous patches of suitable habitat. Increasing the spatial scale of landscape disturbances (such as by applying a pesticide to control an unwanted species) drives down population density because of reasons including dispersal-limited recolonization and the resulting increase in temporal variability. Here, we examine how population density changes as the spatial scale of landscape disturbance increases: does it increase due to increases in spatial correlations in landscape habitat type, or does it decrease due to the various spatial and temporal effects of larger-scale disturbances? We use simulations, mean field approximations, pair approximations, landscape-improved pair approximations (LIPA), and block probabilities to investigate a model of a locally dispersing species on a dynamic landscape with spatiotemporally structured heterogeneous habitat. Pesticide is applied at a given spatial scale, leaving habitat unsuitable for some time before dissipating and allowing the habitat to revert to a suitable state. We found that increasing the spatial scale of disturbances (while keeping the overall disturbance rate fixed) can increase population density, but generally only when landscape

*Corresponding author
Email address: hiebeler@math.umaine.edu (David E. Hiebeler)
URL: http://www.math.umaine.edu/~hiebeler (David E. Hiebeler)