Consequences of ignoring dispersal variation in network models for landscape connectivity

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Lauren L. Sullivan[1,2], Matthew J. Michalska-Smith[3,4], Katie P. Sperry[2,5], David A. Moeller[6], and Allison K. Shaw[2]

[1]Division of Biological Sciences, University of Missouri, Columbia, MO, U.S.A.
[2]Department of Ecology, Evolution, and Behavior, University of Minnesota, Saint Paul, MN, U.S.A.
[3]Department of Veterinary Population Medicine, University of Minnesota, Saint Paul, MN, U.S.A.
[4]Department of Plant Pathology, University of Minnesota, Saint Paul, MN, U.S.A.
[5]Marine and Environmental Sciences, Northeastern University, Boston, MA, U.S.A.
[6]Department of Plant and Microbial Biology, University of Minnesota, Saint Paul, MN, U.S.A.

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Abstract

Habitat loss and fragmentation can negatively impact population persistence and biodiversity, but these effects can be mitigated if species successfully disperse between isolated habitat patches. Network models are the primary tool for quantifying landscape connectivity, yet as practiced, they take an overly simplistic view of species dispersal. These models often ignore individual variation in dispersal ability, assuming all individuals move the same fixed distance with equal probability. Here we develop a modeling approach to address this problem. We incorporate dispersal kernels into network models to determine how individual variation in dispersal alters our understanding of landscape-level connectivity, and test our approach on a fragmented grassland landscape in Minnesota. We show that ignoring dispersal variation consistently overestimates a population's robustness to local extinctions while simultaneously underestimating its robustness to local habitat loss. Furthermore, a simplified view of dispersal underestimates the amount of habitat sub-structure for small populations but overestimates habitat sub-structure for large populations. Our results demonstrate that considering biologically realistic dispersal alters our understanding of landscape connectivity for ecological theory and conservation practice.

Introduction

Loss of habitat due to land-use alteration is one of the largest anthropogenic threats to Earth's planetary systems (Rockström 2009), contributing to major declines in biodiversity (Newbold et al. 2016) and other ecosystem services (Haddad et al. 2015). Habitat loss fundamentally alters landscapes by simultaneously decreasing the overall amount of native habitat, and changing how the remaining habitat patches are arranged with respect to each other