

Inconsistent Effects of Landscape Heterogeneity on Animal Diversity in an Agricultural Mosaic: A Multi-Scale and Multi-Taxon Investigation

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Abstract : A key challenge for the developing world is reconciling biodiversity conservation with the growing demand for food. In these regions, agriculture is typically interspersed among other land-uses creating heterogeneous landscapes. A primary hypothesis for promoting biodiversity in agricultural landscapes is the habitat heterogeneity hypothesis. While there is evidence that landscape heterogeneity positively influences biodiversity, the application of this hypothesis is hindered by a need to determine which components of landscape heterogeneity drive these effects and at what spatial scale(s). Additionally, whether diverse taxonomic groups are similarly affected is central for determining the applicability of this hypothesis as a general conservation strategy in agricultural mosaics. Two major components of landscape heterogeneity are compositional and configurational heterogeneity. Disentangling the roles of each component is important for biodiversity conservation because each represents different mechanisms underpinning variation in biodiversity. We identified a priori independent gradients of compositional and configurational landscape heterogeneity within an extensive agricultural mosaic in north-eastern Swaziland. We then tested how bird, dung beetle, ant and meso-carnivore diversity responded to compositional and configurational heterogeneity across six different spatial scales. To determine if a general trend could be observed across multiple taxa, we also tested which component and spatial scale was most influential across all taxonomic groups combined. Compositional, not configurational, heterogeneity explained diversity in each taxonomic group, with the exception of meso-carnivores. Bird and ant diversity was positively correlated with compositional heterogeneity at fine spatial scales < 1000 m, whilst dung beetle diversity was negatively correlated to compositional heterogeneity at broader spatial scales > 1500 m. Importantly, because of these contrasting effects across taxa, there was no effect of either component of heterogeneity on the combined taxonomic diversity at any spatial scale. The contrasting responses across taxonomic groups exemplify the difficulty in implementing effective conservation strategies that meet the requirements of diverse taxa. To promote diverse communities across a range of taxa, conservation strategies must be multi-scaled and may involve different strategies at varying scales to offset the contrasting influences of compositional heterogeneity. A diversity of strategies are likely key to conserving biodiversity in agricultural mosaics, and we have demonstrated that a landscape management strategy that only manages for heterogeneity at one particular scale will likely fall short of management objectives.

Keywords : agriculture, biodiversity, composition, configuration, heterogeneity

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