ABSTRACT OF DISSERTATION

EFFECTS OF SPATIAL HETEROGENEITY ON NATIVE AND NONNATIVE PLANT AND BUTTERFLY SPECIES RICHNESS IN ROCKY MOUNTAIN NATIONAL PARK, COLORADO, USA

Spatial heterogeneity may have differential effects on the distribution of native and nonnative plant and butterfly species richness and their interactions. These effects may be scale dependent and may vary for different levels of biological organizations (e.g., landscape-level versus land cover type level native and nonnative plant species richness, or total versus family level butterfly species richness ). I quantified spatial heterogeneity in vegetation, soil, topography, and landscape patterns (composition and configuration) in Rocky Mountain National Park, Colorado, and related it to native and nonnative plant and butterfly species richness. The landscape metrics represented five components of landscape heterogeneity and were measured at multiple spatial extents (within varying radii) around sample plots (20 x 50 m) using FRAGSTATS landscape pattern analysis program. Akaike’s Information Criterion adjusted for small sample size (AICc) was used to select the best models from a set of multiple linear regression models developed for native and nonnative plant and butterfly species richness at multiple spatial extents and different levels of biological organizations. For plant species, the best models explained 43% of the variation in native plant species richness and 70% of the variation in nonnative plant species richness at 240-m spatial extent. For butterfly species, the best model explained 62% of the variation in total butterfly species richness (2100-m spatial extent). Native and nonnative plant and butterfly species richness predictive models were significantly improved by including landscape metrics in addition to variables representing vegetation, soil and topographic heterogeneity. The role of spatial autocorrelation in native-exotic plant species richness relationships was also investigated. Principal coordinates of neighbor matrices (PCNM) approach and conditional autoregressive regression (CAR) were used to quantify broad-scale spatial dependence and fine-scale spatial autocorrelation, respectively. Modified variation partitioning showed that ‘space’ and ‘spatially structured environmental processes’ are relatively more important in shaping the native-exotic plant species richness relationships than native plant species richness alone. This study offers an approach to quantify spatial heterogeneity and spatial autocorrelation, and the results suggest that wider landscape context should be considered in managing native and nonnative plant and butterfly species.

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Spring 2007