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Multiple-region, N-mixture community models to assess associations of riparian area, fragmentation, and species richness

The associations of habitat area and fragmentation with species richness long have been major topics within community ecology. The habitat amount hypothesis, that more variability in species richness is explained by the amount of habitat in the sampling area than by the size or isolation of habitat patches, suggests that species richness may not decline as habitat fragmentation increases. We created a novel, multiple-region, N-mixture community model (MNCM) to examine the relations of riparian area and fragmentation with species richness of breeding birds in mountain ranges within the Great Basin, Nevada, USA. Our MNCM accounts for imperfect detection in count data at the survey-point level while allowing comparisons of species richness among regions in which those points are embedded. We used individual canyons within mountain ranges as regions in our model and measured riparian area and the normalized landscape shape index, a metric of fragmentation that is independent of total riparian area. We found that riparian area, but not its fragmentation, was a primary predictor of canyon-level species richness of both riparian obligates and all species. This result is consistent with the habitat amount hypothesis. The relation between riparian area and riparian-obligate species richness was nonlinear: canyons with ≥ 25 ha woody riparian vegetation had relatively high species richness, whereas species richness was considerably lower in canyons with <25 ha. Our MNCM can be used to calculate other metrics of diversity that require abundance estimates. For example, Simpson's evenness of riparian obligate species had a weak negative association with riparian area and was not associated with fragmentation. Projections of future riparian contraction suggested that decreases in species richness are likely to be greatest in canyons that currently have moderate (~10-25 ha) amounts of riparian vegetation. Our results suggest that if a goal of management is to maximize the species richness of breeding birds in montane riparian areas in the Great Basin, it may be more effective to focus on total habitat area than on fragmentation of patches within canyons, and that canyons with at least moderate amounts of riparian vegetation should be prioritized.