

Modeling the effects of forest harvesting on landscape structure and the spatial distribution of cowbird brood parasitism

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Abstract

Timber harvesting affects both composition and structure of the landscape and has important consequences for organisms using forest habitats. A timber harvest allocation model was constructed that allows the input of specific rules to allocate forest stands for clearcutting to generate landscape patterns reflecting the "look and feel" of managed landscapes. Various harvest strategies were simulated on four 237 km² study areas in Indiana, USA. For each study area, the model was applied to simulate 80 years of management activity. The resulting landscape spatial patterns were quantified using a suite of landscape pattern metrics and plotted as a function of mean harvest size and total area of forest harvested per decade to produce response surfaces. When the mean clearcut size was 1 ha, the area of forest interior remaining on the landscape was dramatically reduced and the amount of forest edge on the landscape increased dramatically. The potential consequences of the patterns produced by the model were assessed for a generalized neotropical migrant forest bird using a GIS model that generates maps showing the spatial distribution of the relative vulnerability of forest birds to brood parasitism by brown-headed cowbirds. The model incorporates the location and relative quality of cowbird feeding sites, and the relation between parasitism rates and distance of forest from edge. The response surfaces relating mean harvest size and total area harvested to the mean value of vulnerability to cowbird brood parasitism had a shape similar to the response surfaces showing forest edge. The results of our study suggest that it is more difficult to maintain large contiguous blocks of undisturbed forest interior when harvests are small and dispersed, especially when producing high timber volumes is a management goal. The application of the cowbird model to landscapes managed under different strategies could help managers in deciding where harvest activity will produce the least negative impact on breeding forest birds.

Keywords: Spatial pattern, timber harvest, clearcutting, GIS model, habitat fragmentation, forest interior, forest edge, brown-headed cowbird, brood parasitism, neotropical migratory birds.