From simulated land use change to changes in the structure of habitat networks

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Abstract

The accelerated pace of land-use and climate change is closing the window of opportunity to manage landscapes for biodiversity and ecosystem services. It is thus urgent to better understand the links between spatio-temporal landscape dynamics, biodiversity and ecosystem services to inform land-planning and decision-making.
To investigate this link, we analyze for 14 vertebrate species the impact of simulated land-use change on the structure of their habitat network over time, in the highly fragmented region surrounding Montreal (Quebec, Canada). At each time step, the landscape and the habitat networks are described with a set of metrics. Redundancies among metrics is summarized with an ordination analysis. Analyzing the trajectories of change along the dominant axes of variation, we show (i) that changes in the structure of habitat network is already well described by basic landscape metrics, (ii) that species displayed contrasting responses to land-use change, (iii) that the effects of land-use change on the structure of habitat networks are very different from random changes. Finally we explore different scenarios of land-use change to show that for the same amount of land-use change, alternative spatial configurations exist that favor sets of species with different degrees of vulnerability to fragmentation. Our results highlight the importance of properly simulating land-use change. This makes it possible to disentangle the effects of landscape composition and configuration, and to explore the trade-offs that exist between different scenarios and their effects on the conservation of species with contrasting life-histories and ecological requirements.

Keywords: land use modelling, graph topology, landscape metrics, habitat connectivity, future scenarios

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