Modelling landscape connectivity at local and regional scales using an empirical quantification of resistance: an application for the conservation of the greater horseshoe bat

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Abstract

In the context of habitat fragmentation, evaluating landscape connectivity for identifying and protecting linkages have become central challenges in applied ecology and conservation. This connectivity is usually assessed with landscape modelling, but several studies pointed out the importance of parameterization with empirical, biologically relevant proxies of factors affecting movements and also the need to validate the models with independent dataset. Here we used the least-cost path analysis (LCP) incorporating quantitative, empirical data about fine-scale behaviour of the greater horseshoe bat *Rhinolophus ferrumequinum* – a widespread bat species in Europe, with major declines recorded this century, particularly in northern Europe – to build up a model of functional connectivity in relation to landscape connecting features. We then validated the accumulated costs surface from the LCP model with two independent datasets, one at an individual level with radio tracking data and one at a population level with acoustic data.

When defining resistance at fine scale, we found that the probability of bat presence in a hedgerow is higher when the distance between hedgerows is below 38 m, and decrease rapidly

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when gaps are larger than 50 m. The LCP model was validated by both datasets: using acoustics, bat presence was higher in areas with lower accumulated costs, and radio tracked bats foraged more likely in areas where accumulated costs were lower.
Finally, we applied this connectivity model at a regional scale (200 km wide) to identify relevant corridors between important breeding and wintering sites. The model output was tested against data from more than 2180 PIT-tagged greater horseshoe bats controlled in $>$ 300 sites distributed throughout the Nouvelle Aquitaine region and bordering departments, allowing linking individual movements between these sites as a function of their connectivity.