Taking into account a distance decay of the landscape effect when modelling ecological responses

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Abstract

Both local characteristics and larger scale landscape variables affect biological responses. Usually landscape effects are studied measuring landscape variables within discs. This assumes that the effect of a unit area of the landscape is constant up to a threshold distance and drops suddenly to zero above this distance. However we think that the landscape effect should depend more continuously on the distance to the point where the biological response is measured. We developed a method to take into account landscape effects by weighting landscape variables by functions decreasing with the distance. Then, we compared this new approach with the classical approach. A weighting function of the distance was defined both by the function family (e.g. negative exponential, Gaussian, step...) and by the parameters for this function. We tested the method in several situations using abundance data on birds and insects. In each situation, we determined the weighting function to use (family and parameters) by the optimization of a criterion of the model (e.g. R-squared or AIC). Our results showed that our method improves model performances in most situations. The shapes of the optimized weighting functions were very different from the step shapes assumed by the classical method. Our method seems promising, and can give useful information about the spatialization of the landscape effects. We encourage landscape ecologists to test this method and compare it to the classical method to acquire more knowledge about its capabilities.

Keywords: best model, biodiversity, landscape ecology, modeling, scale of effect, spatial ecology, weighting function

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